

BULL MOUNTAIN COAL FIELD
STUDY

PROGRESS REPORT, 1973

MONTANA DEPARTMENT OF FISH AND
GAME ENVIROMENT AND INFORMATION
DIVISION AND

CONSOLIDATED COAL COMPANY

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BULL MOUNTAINS COAL FIELD STUDY

Progress Report, 1973

Research Conducted by:

MONTANA DEPARTMENT OF FISH AND GAME
Environment and Information Division

and

CONSOLIDATION COAL COMPANY

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July 30, 1973

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INTRODUCTION

Wildlife, both game and nongame species, is a product of and dependent upon its environment. One might easily conclude that any sudden disturbance or alteration of the natural environment would have a detrimental impact upon this resource.

With the advent of coal development by surface mining in southeastern Montana, many questions arise concerning the impact upon resident wildlife occupying this portion of the state as well as on the total environment. Questions include: Once an area is mined, can habitat conditions needed to maintain stable, exploitable and diverse wildlife populations be achieved through reclamation? Should an area which includes critically important habitat be considered for surface mining? and, How can any destruction or enhancement of habitat values through surface mining and subsequent reclamation occur or be adequately measured?

Ecological data concerning strip mined lands and wildlife are generally lacking. Studies such as those of Brewer (1958), Vertz (1960) and Karr (1968) entail mostly studies of song birds and small mammals on land with little or no reclamation, and they're confined to the midwest states. Knife River Coal Company in western North Dakota terms some of its reclaimed spoils as wildlife management areas (Gwynn, 1966), but the specific details are lacking.

The present study was undertaken in the Bull Mountains by the Montana Department of Fish and Game in cooperation with Consolidation Coal Company. The study includes the following overall objectives: (1) To determine the impact of present and future surface mining upon the wildlife resource in this area, (2) To insure that wildlife habitat values receive full recognition in any surface reclamation efforts following mining, and (3) To investigate possible modifications or innovations in the reclamation process to avoid unnecessary loss of wildlife habitat.

Goals attempted during this initial report period were to inventory and gain basic ecological data on game species and nongame mammals, determine vegetation types occurring in the area and their relative use by wildlife, and identify areas for a more comprehensive study of various ecological aspects.

STUDY AREA

Location

The Bull Mountains (Figure 1), in southeastern Montana, lie south of the Musselshell River primarily in Musselshell County with small portions in Yellowstone and Golden Valley Counties. The area is used largely for livestock production, with some of the more gentle terrain, primarily around the periphery and in the lower drainages, presently under cultivation. Approximately 86,000 acres of commercial timber occur in the region also (U. S. Department of Interior, B.L.M., 1973).

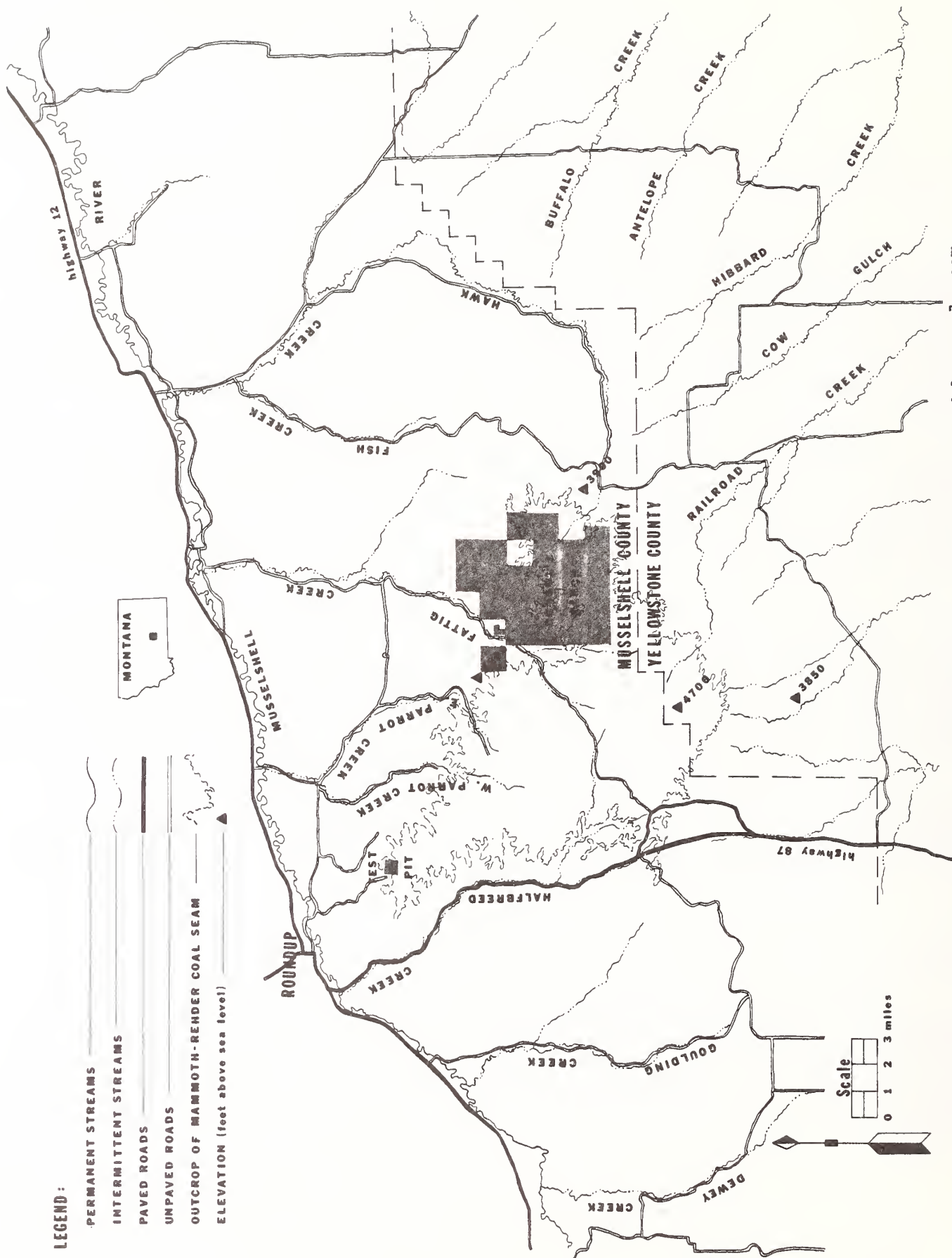


Figure 1. Map of the Bull Mountains showing the outcrop of the Mammoth-Rehder coal seam.

Physiography

The area, consisting of two levels or plateaus with a difference in elevation of approximately 500 feet, forms the divide between the Musselshell drainage to the north and the Yellowstone to the south (Gieseke, 1939). The higher level, consisting of scoria-capped mesas, has a maximum elevation of 4700 feet above sea level. The lower level, a dissected plateau, has a maximum elevation of 4200 feet. High cliffs and rimrocks formed from sandstones of the Fort Union formation border many of the lower drainages. Other substrata include siltstones and shales. The Mammoth-Rehder coal seam lies underneath (Figure 1). Soils of the area are characterized by loams of the Bainville series in the uplands and loams of the Jordan series on the valley slopes.

Climate

Gieseke (1939) has described the climate as semiarid, characterized by comparatively low rainfall, great temperature extremes and relatively low humidity. Climatological data were taken from data recorded at Roundup (U.S. Department of Commerce, 1972-73). Monthly data are shown in Appendix Table 15.

Average temperatures during January, 1972 were below normal as compared to near normal temperatures during January, 1973. Average temperatures during February of both years were slightly above normal. The spring of 1972 was characterized by above normal temperatures, especially during March. During summer, June and August were characterized by above normal average temperatures as compared to below normal during July. Below normal average temperatures were reported during the period of September, 1972 through December, 1972.

The area received 13.2 inches of moisture during 1972 as compared to a normal of 10.93 inches. April, May, July and August were the wettest months, and total precipitation was far above normal (Appendix Table 15). Precipitation, in the form of snow, during January and February, 1973 was far below normal.

Vegetation

Seven different vegetation types occur in the Bull Mountains. Types were quantitatively sampled by a canopy coverage method similar to that described by Daubenmire (1959), but the data will not appear until a later report. The following description of vegetation types is only qualitative. Plant taxa collected and identified during the spring and summer of 1972 are listed in Appendix Table 16. Common and scientific names of plants were from Booth (1950) and Booth and Wright (1959).

Grassland Type

This type occurred in open parks on plateaus and ridges and in drainage bottoms. Many of these areas, apparently under cultivation at one time, have since reverted back to native range vegetation. Grasses occurring on this type included cheatgrass (Bromus spp.), blue grama (Bouteloua gracilis), western wheatgrass (Agropyron smithii) and green needlegrass (Stipa viridula). Broom snakeweed (Gutierrezia sarothrae), a forb, thrived on many sites. Other forbs

commonly observed included common dandelion (Taraxicum officinale), common salsify (Tragopogon dubius) and yarrow (Achillea millefolium). Shrubs, sparsely scattered, included skunkbush sumac (Rhus trilobata), silver sagebrush (Artemisia cana), snowberry (Symphoricarpos spp.) and wild rose (Rosa spp.).

Cropland Type

This type included cereal grains and summerfallow occurring primarily on plateaus, drainage bottoms and gentle slopes.

Hay Meadow Type

This, like the cropland type, represented an agricultural disturbance and occurred on the same type of slope as the cropland type. Domestic grasses occurred on many of the meadows and a combination of alfalfa (Medicago sativa) and grasses in others. Broom snakeweed occurred in many of the meadows.

Sagebrush-Grassland Type

This type represented various degrees of association and dominance between sagebrush, grasses and forbs. Silver sagebrush prevailed over much of the study area, but big sagebrush (Artemisia tridentata) occurred in the southern portion of Musselshell County and in Yellowstone County.

Deciduous Shrub Type

Several subtypes were identified but not distinguished during this initial report. Shrubs occurring in this type included skunkbush sumac, snowberry, chokecherry (Prunus virginiana), currant (Ribes spp.) and wild rose.

Ponderosa Pine-Bunchgrass Type

Ponderosa pine (Pinus ponderosa), the only species of timber known to occur in the Bull Mountains, and bluebunch wheatgrass (Agropyron spicatum) appeared to be the major species in this type. These sites included broken parks and timbered areas where the tree canopy was open enough to allow a substantial cover of understory vegetation. Shrubs, including skunkbush sumac, silver sagebrush, Rocky Mountain juniper (Juniperus scopulorum) and common juniper (J. communis) were found throughout this type.

Ponderosa Pine Type

This consisted of homogeneous stands of ponderosa pine where the dense canopy of timber prevented development of understory vegetation. These stands of timber occurred primarily on north-facing slopes.

PHASES OF STUDY

The present study has been divided into four separate phases. Included are a general wildlife ecology study, a rest-rotation grazing study on property owned and leased by Consolidation Coal Company (Consol), a revegetation study at Consol's test pit in the Bull Mountains, and a nongame mammal inventory. All data, except from the revegetation study at the test pit, were considered pre-mining data.

General Wildlife Ecology Study

The purpose of this phase was to determine specific habitat requirements of game species in the Bull Mountains, to use the data for determining whether or not certain areas should be mined, and to suggest how mined areas can be reclaimed to fulfill requirements of game animals.

Mule deer (Odocoileus hemionus), elk (Cervis canadensis) and Merriam's turkey (Meleagris gallopavo merriami) were the most commonly observed game species in foothill areas where mining will most likely occur. A few sharp-tailed grouse (Pedioecetes phasianellus) and pronghorn (Antilocapra americana) were also observed in these areas. White-tailed deer (Odocoileus virginiana) and ring-necked pheasants (Phasianus colchicus) were associated with the tree and shrub vegetation along the Musselshell River bottom although whitetails were occasionally observed in the foothills adjacent to the river. Only the first three species mentioned will be discussed in any detail.

Animals, when observed either from a fixed-wing aircraft or from the ground, were classified as to sex and whether adult or young. The vegetation type and class of slope the animal occupied were noted as well as its location to the nearest section. Rumens, collected for the purpose of studying food habits of mule deer, were analyzed by a method similar to that used by Wilkins (1957) and others. Feeding sites, areas of recent use by feeding animals, were examined shortly after being vacated during summer and winter to gain food habit data for these two seasons. One bite on a plant constituted one instance of use. Results from this method as well as rumens were tabulated by the aggregate percentage method (Martin et al, 1946).

Mule Deer

Distribution and Range Use

Mule deer were observed throughout the entire Bull Mountains area, but appeared to be concentrated in certain areas as shown in Figure 2. Areas of concentration did not change appreciably from one season to another, suggesting that mule deer in this area were nonmigratory. Any seasonal shifts appeared to be associated with changes in preferences for vegetation types and various classes of slope. This was similar to findings in other areas of eastern Montana (Mackie, 1970; Dusek, 1971; and Knapp, 1972).

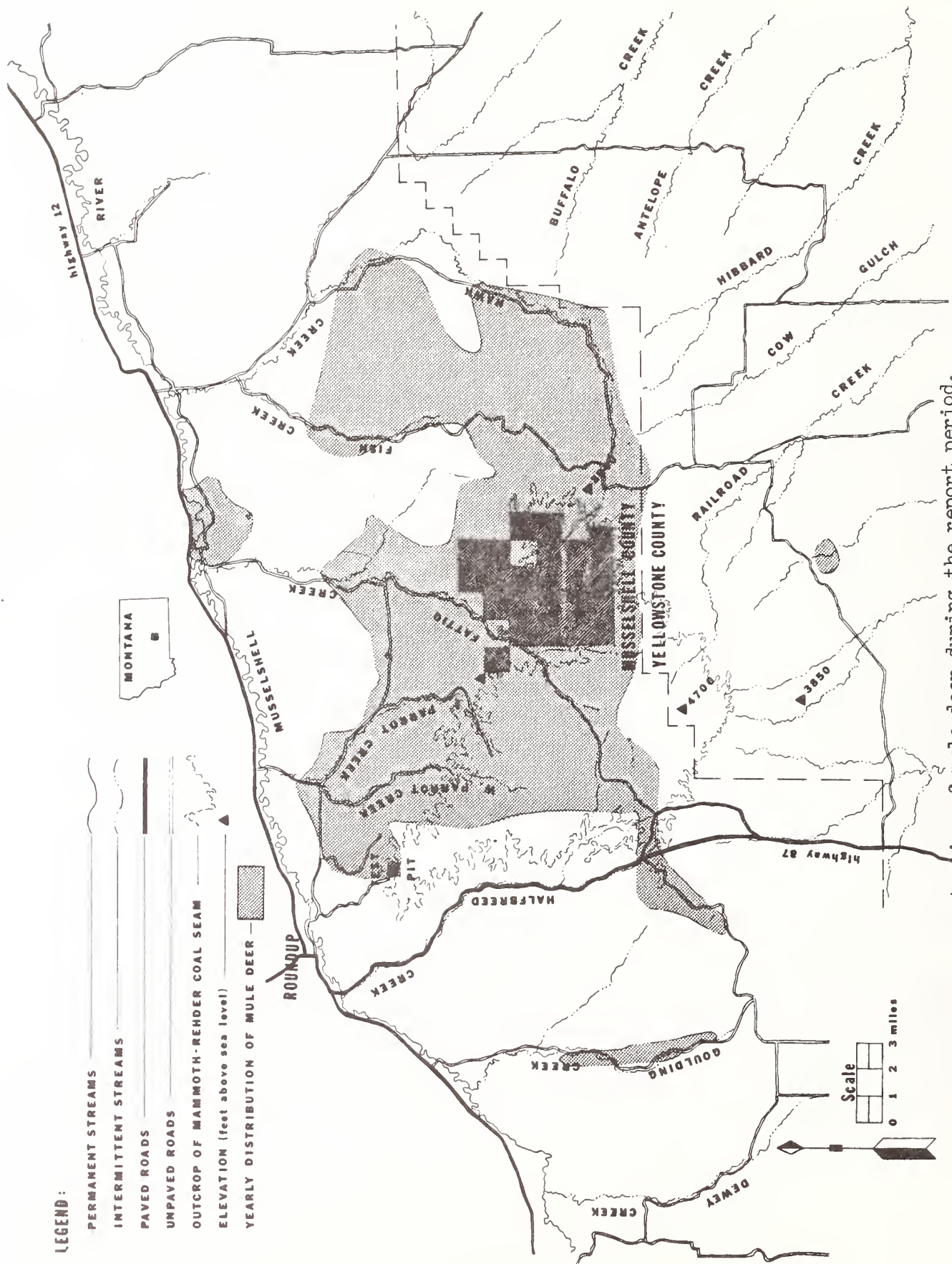


Figure 2. Areas of concentration of mule deer during the report period.

Average group sizes of mule deer varied from 6.3 animals per group during winter to 2.0 animals during summer. Average group sizes during spring and fall were intermediate to those of winter and summer.

Aerial and ground data have been combined in the following analysis. Range use data were based on 3185 observations.

Use of Vegetation Types

Since observations of mule deer were associated with periods of activity such as feeding, use of the timbered types may have been underestimated. When alarmed or after periods of feeding, deer used timbered types for escape cover and many were observed bedding in these types.

Winter: During the winter of 1971-72, 66 percent of the observations of mule deer were in the ponderosa pine-bunchgrass type (Table 1). This winter was characterized by greater amounts of precipitation, in the form of snow, and colder temperatures as compared to the succeeding winter of 1972-73 (Appendix Table 15). During the mild winter of 1972-73, 23 percent of the observations were in the ponderosa pine-bunchgrass type. Twenty-one percent were in the grassland type during the winter of 1972-73 as compared to 13 percent the previous winter (Table 1). The percentage of observations in the hay meadow, sagebrush-grassland and deciduous shrub types during 1972-73 was twice that recorded during the winter of 1971-72. Use of vegetation types by mule deer during winter in the Bull Mountains was similar to that observed by Martinka (1968) and Knapp (1972).

Spring: The grassland and ponderosa pine-bunchgrass types received 30 and 27 percent, respectively, of the use by mule deer during this season in 1972 (Table 1). The cropland and hay meadow types each accounted for 16 percent of the observations. Use of these two types appeared to correspond with early spring greenup when such areas become attractive to deer.

Summer: During this season the grassland type was most important and reached its highest annual use accounting for 38 percent of the seasonal observations. The ponderosa pine-bunchgrass type was second in importance, with 23 percent of the observations (Table 1). Observations in the deciduous shrub type increased to 11 percent as compared to 1 percent during spring. The cropland type was not used as heavily during summer as compared to spring, since it accounted for only 5 percent of the seasonal observations. Many drainage bottoms dominated by the grassland type were heavily grazed by livestock during this season. For the most part, deer appeared to avoid these areas because most observations of deer in the grassland type were in areas where a lush growth of vegetation occurred.

Fall: During this season 28 percent of the observations of mule deer were in the grassland type, followed by the hay meadow type with 23 percent. The deciduous shrub type accounted for 16 percent of the observations, representing an increase over summer for this type. The cropland type accounted for 14 percent of the seasonal observations, also representing an increase over summer observations (Table 1).

Table 1. Seasonal use of vegetation types by mule deer as determined from ground and aerial data combined based on 3,185 observations.

Season	<u>Vegetation Type</u>						
	Ponderosa Pine	Ponderosa Pine-Bunch- grass	Grassland	Cropland	Hay Meadow	Sagebrush- Grassland	Deciduous Shrub
Winter, 1972 (268) ^{1/}	3 ^{2/}	66	13	tr ^{3/}	7	4	6
Spring, 1972 (850)	2	27	30	16	16	8	1
Summer, 1972 (565)	tr	23	38	5	13	9	11
Fall, 1972 (788)	-	13	28	14	23	6	16
Winter, 1972-73 (714)	1	23	21	1	19	17	17

^{1/} Sample size for respective season.

^{2/} Percent of seasonal observations.

^{3/} Trace - less than one percent of seasonal observations

Use of Slopes

Winter: Sixty-four and 34 percent of the observations of mule deer occurred on sidehills during the winters of 1971-72 and 1972-73, respectively (Table 2). Here again, differences between the two winters, mentioned previously, may have influenced use by deer of the various classes of slope. During the mild winter of 1972-73, a greater percentage of mule deer occupied coulee bottoms, coulee heads and plateaus than during the previous winter when depths of snow in many of these areas may have precluded use by deer. Loveless (1967) concluded that snow depths of 20-24 inches precluded the use of an area by deer.

Spring: Forty-one and 26 percent of the observations occurred on sidehills and creek bottoms, respectively. The increase in observations on creek bottoms, from winter to spring of 1972, corresponded with increased use of hay meadow and cropland types during the spring greenup.

Summer: The greatest number of observations during this season, 31 percent, occurred in coulee bottoms. This corresponded with the percentage of deer observed in the grassland type when forbs were most important in the diet. Even though use of coulee bottoms was higher than during any other season, deer were seldom observed in coulee and creek bottoms where heavy grazing by livestock occurred. Deer appeared to prefer areas where livestock grazing was light or absent. Twenty-five and 16 percent of the observations occurred on sidehills and creek bottoms, respectively.

Table 2. Seasonal use of the various classes of slope by mule deer as determined from ground and aerial data combined based on 3,185 observations.

Season	<u>Class of Slope</u>					
	<u>Sidehill</u>	<u>Coulee Bottom</u>	<u>Creek Bottom</u>	<u>Ridge</u>	<u>Plateau</u>	<u>Coulee Head</u>
Winter, 1972 (268) ^{1/}	64 ^{2/}	6	8	9	13	-
Spring, 1972 (850)	41	8	26	11	14	1
Summer, 1972 (565)	25	31	16	7	14	7
Fall, 1972 (788)	20	18	17	9	28	9
Winter, 1972-73 (714)	34	16	9	9	22	10

^{1/} Sample size for a respective season.

^{2/} Percentage of seasonal observations.

Fall: Plateaus accounted for 28 percent of the observations during the fall of 1972, which appeared to correspond with use of the hay meadow and cropland types (Tables 1 and 2). Sidehills, coulee bottoms and creek bottoms constituted 20, 18 and 17 percent of the seasonal observations, respectively.

Use of Exposures

During both winters, more than 60 percent of the observations associated with some degree of slope occurred on southerly exposures. These exposures receive greater amounts of sunlight during this season than do northerly exposures and large accumulations of snow generally do not occur in these areas. Shrubby vegetation, the major item in the diet of mule deer during this season, appeared more abundant on southerly exposures as compared to northerly exposures, which are dominated by timber. During other seasons there was no observed preference for exposures during periods of activity.

Food Habits

Food habits during winter and summer were estimated by the use of feeding site examinations. Sample sizes were small, but trends in seasonal food habits were apparent. Data for the two winters were combined. Rumen samples from hunter-killed deer were used to estimate food habits during fall. Four browse utilization transects, read in the spring and fall, aided in determining relative use and periods of use for what were considered the key browse species in the Bull Mountains.

Winter: Browse and forbs accounted for 89 and 10 percent of the diet, respectively, as determined from 9 feeding site examinations which included 1,252 instances of use. Browse attained its highest seasonal usage during this season (Table 3). Silver sagebrush, which accounted for 34 percent of the diet during this season, was the most important item. Skunkbush sumac and common juniper followed and accounted for 25 and 12 percent of the diet, respectively. Silver sagebrush did not appear to be utilized as heavily in the sagebrush-grassland type as it did in areas such as the ponderosa pine-bunchgrass type where sagebrush plants were sparsely scattered and mixed with other shrubs used by mule deer during winter. Soap-weed (Yucca glauca), which remained green throughout the winter, was the most important forb and constituted 3 percent of the diet. Use of grasses by mule deer during winter was negligible.

Data from browse utilization transects indicated that the annual leader growth of sagebrush and skunkbush sumac was used primarily during winter with little or no use in other seasons. The average leader use on silver sagebrush varied from 43 to 52 percent when transects were read following the winter of 1971-72. In November, 1972, the leader use on this plant amounted to less than 2 percent. For skunkbush sumac, average leader use varied from 13 to 30 percent following the winter of 1971-72 and averaged 3 percent in November, 1972. In general, silver sagebrush plants appeared in fair condition with only moderate hedging, but many skunkbush sumac plants were severely hedged.

An average leader use of 58 percent was recorded for one transect on green rabbitbrush (Chrysothamnus viscidiflorus) and 90 percent for a transect on rubber rabbitbrush (C. nauseosus) following the winter of 1971-72. These two plants were very limited in distribution and probably important to mule deer only in specific locations. The same two transects were again read in November, 1972, and the average leader use was 30 and 39 percent, respectively. This indicated that the two species were used during both fall and winter, but some of the use may be attributed to livestock.

Summer: Food habits for this season were based on 5 feeding sites which included 118 instances of use. Forbs comprised the most important forage class in the diet, 69 percent, followed by browse, which constituted 28 percent. The most abundant forb was common salsify which constituted 54 percent. Other forbs in the diet included wild lettuce (Lactuca serriola) and yellow sweetclover (Melilotus officinalis) (Table 3). Deciduous shrubs made up the rest of the diet with leaves of golden currant (Ribes aureum) and skunkbush sumac accounting for 11 and 9 percent, respectively. Others are shown in Table 3. There was no use recorded on the grass forage class during this season.

Fall: Food habits during this season were based on three rumen samples collected during October and November of 1972. Use of browse by mule deer, 46 percent by volume, indicated an increase in the use of this forage class from summer (Table 3). Snowberry, which was the most important item during this season, accounted for 42 percent of the diet. Other shrubs making up 1 percent or more of the diet during this season included skunkbush sumac and wild rose. Forbs accounted for 43 percent of the seasonal diet. Canadian thistle (Cirsium arvense) was the most abundant, accounting for 18 percent. The grass forage class accounted for 12 percent of the volume of the 3 rumens.

Table 3. Seasonal food habits of mule deer as determined from feeding site examinations and rumen samples.

Taxa	Winter 9 sites (1282) ^{1/}	Summer 5 sites (118)	Fall 3 rumens
<u>Browse</u>			
Artemisia cana	55/34 ^{2/}	--/--	33/tr
Juniperus communis	33/12	--/--	--/--
Juniperus horizontalis	11/11	--/--	--/--
Pinus ponderosa	22/ 6	--/--	--/--
Populus deltoides	--/--	--/--	33/tr
Prunus virginiana	--/--	20/ 1	--/--
Rhus trilobata	55/25	20/ 9	67/ 1
Ribes aureum	--/--	20/11	--/--
Rosa spp.	11/ 1	20/ 5	100/ 2
Symphoricarpos spp.	11/tr ^{3/}	20/ 2	100/42
Unknown shrubs	<u>11/tr</u>	<u>--/--</u>	<u>67/ 1</u>
Total Browse	100/89	40/28	100/46
<u>Forbs</u>			
Artemisia frigida	33/ 2	--/--	--/--
Artemisia ludoviciana	22/ 1	--/--	--/--
Aster spp.	11/ 2	--/--	33/ 1
Chrysopsis villosa	11/tr	--/--	--/--
Cirsium arvense	11/ 1	--/--	33/18
Eriogonum spp.	--/--	--/--	33/tr
Guttierrezia sarothrae	22/tr	--/--	--/--
Lactuca serriola	--/--	40/ 4	--/--
LEGUMINOSAE	22/1	--/--	67/ 1
Melilotus officinalis	--/--	40/11	67/tr
Solidago spp.	22/tr	--/--	--/--
Tragopogon dubius	11/tr	80/54	--/--
Yucca glauca	22/ 3	--/--	--/--
Unknown forbs	<u>--/--</u>	<u>--/--</u>	<u>100/23</u>
Total Forbs	67/10	80/69	100/43
Grasses	<u>22/tr</u>	<u>--/--</u>	<u>100/12</u>
Total Grasses	22/tr	--/--	100/12

^{1/}The number of instances of use

^{2/}Frequency (percent occurrence among feeding sites or rumens)/percent of seasonal diet

^{3/}tr - percent of seasonal diet is less than .5 percent

Population Characteristics

Based on 90 observations of mule deer during January and February of 1972, a fawn:adult ratio of 55:100 was calculated (Table 4). Sex of adults was not readily determined during late February, so a fawn:doe ratio was not available. Aerial data did not closely agree with that from the ground, perhaps because deer observed from the air were difficult to classify to age during this time of year. The fawn:adult ratio from 635 ground observations during spring of 1972 was 34:100 indicating a substantial decrease in the number of fawns per adult from winter to spring. Two dead fawns were found in the area following the winter of 1971-72. Examination of marrow in the femur indicated that both suffered from malnutrition (Greer, 1969). The winter of 1971-72 was considered severe, and forage conditions may not have met the growth and metabolic requirements of fawns. Since livestock were left on the range in many areas, interspecific competition for forage may have been a contributing factor.

During the summer of 1972 newly born fawns were not readily observable until the middle of August, so fawn:doe and fawn:adult ratios were not calculated for this period. During the fall of 1972 fawn:doe and fawn:adult ratios, based on 306 ground observations, were 34:100 and 27:100, respectively (Table 4). Data from 442 aerial observations closely agreed with data from ground observations; i.e., 32:100 and 24:100, respectively. These ratios did not change appreciably during the winter of 1972-73 when the fawn:doe and fawn:adult ratios from ground observations, based on a sample size of 275 deer, were 32:100 and 26:100, respectively. Respective ratios from aerial observations during this season, based on a sample size of 439 deer, were 29:100 and 24:100.

From examining the data in Table 4, one can compare the two fawn crops. The fawn:adult ratios during the fall of 1972 and winter of 1972-73 never did approach the respective figure for the previous fawn crop at its lowest level during the spring of 1972.

Table 4. Population characteristics of mule deer as determined from 1691 ground observations from January, 1972 - February, 1973.

	Adults				Fawns	Uncl. Sex & Age	Total		
	Females	Males	Uncl.	Total				Fawns: 100 Females	Fawns: 100 Adults
Winter, 1972 (Jan. & Feb.)	43	3	10	56	31	3	90	-	55:100
Spring, 1972	155	55	216	426	144	65	635	-	34:100
Summer, 1972	240	126	1	367	18	-	385	-	-
Fall, 1972	193	48	-	241	65	-	306	34:100	27:100
Winter, 1972-73	174	27	10	211	55	9	275	32:100	26:100

Elk

Residents in the Bull Mountains first reported seeing elk during the 1950's. Since elk were never transplanted to the area, there are several opinions concerning the origin of the population.

Until the present time, there has been no legal hunting of elk in this area. A special archery season is scheduled for the fall of 1973 on property controlled by Consolidation Coal Company.

Distribution and Range Use

Distribution and range use are based on 200 observations of elk during the report period. The sample size is small, but some trends are apparent. More data are necessary to draw any far-reaching conclusions.

Data from ground and aerial observations combined, indicated that three to four herd segments of resident elk occur in the area. Mackie (1970) felt there was an interchange of animals between herd segments in the Missouri breaks, an area similar to the Bull Mountains in topography and vegetation. The same situation may occur in the Bull Mountains, but quantitative data are limited. The distribution of all observations of elk for the report period appears in Figure 3.

Composition and distribution of herd segments varied throughout the year. During the period of January through April, 1972, cows and calves were observed in groups varying from 7 to 12 animals per group. Bull groups, never observed with cow/calf groups during this period, varied from one to six. From May through August, all animals observed were solitary. Bulls were first observed with cow/calf groups during fall, when groups varied in size from 2 to 22 and contained from 1 to 3 bulls. All observations of elk were in precipitous terrain, primarily above 4,000 feet, throughout the year--except during the fall breeding season when several observations were below this elevation, primarily in the upper ends of major drainages.

Use of Vegetation Types

Spring: During spring, 1972, 47 percent of the observations of elk occurred in the grassland type as compared to the hay meadow and sagebrush-grassland types which accounted for 28 and 22 percent, respectively (Table 5). Only 3 percent of the observations occurred in the ponderosa pine-bunchgrass type during this season. These observations may not accurately reflect the role that timbered types play in the daily activities of elk, because all observations were obtained during early morning and evening hours when elk were active. Elk were more difficult to observe in the timber, but were often observed using timber as escape cover when alarmed by the observer.

Summer: Only two observations of elk were made from June through August, 1972. One occurred in the grassland type and the other in the ponderosa pine-bunchgrass type. Data for this season were obviously too scanty to draw any conclusions. Mackie (1970) found that greatest usage during summer occurred on timbered types in the Missouri breaks.

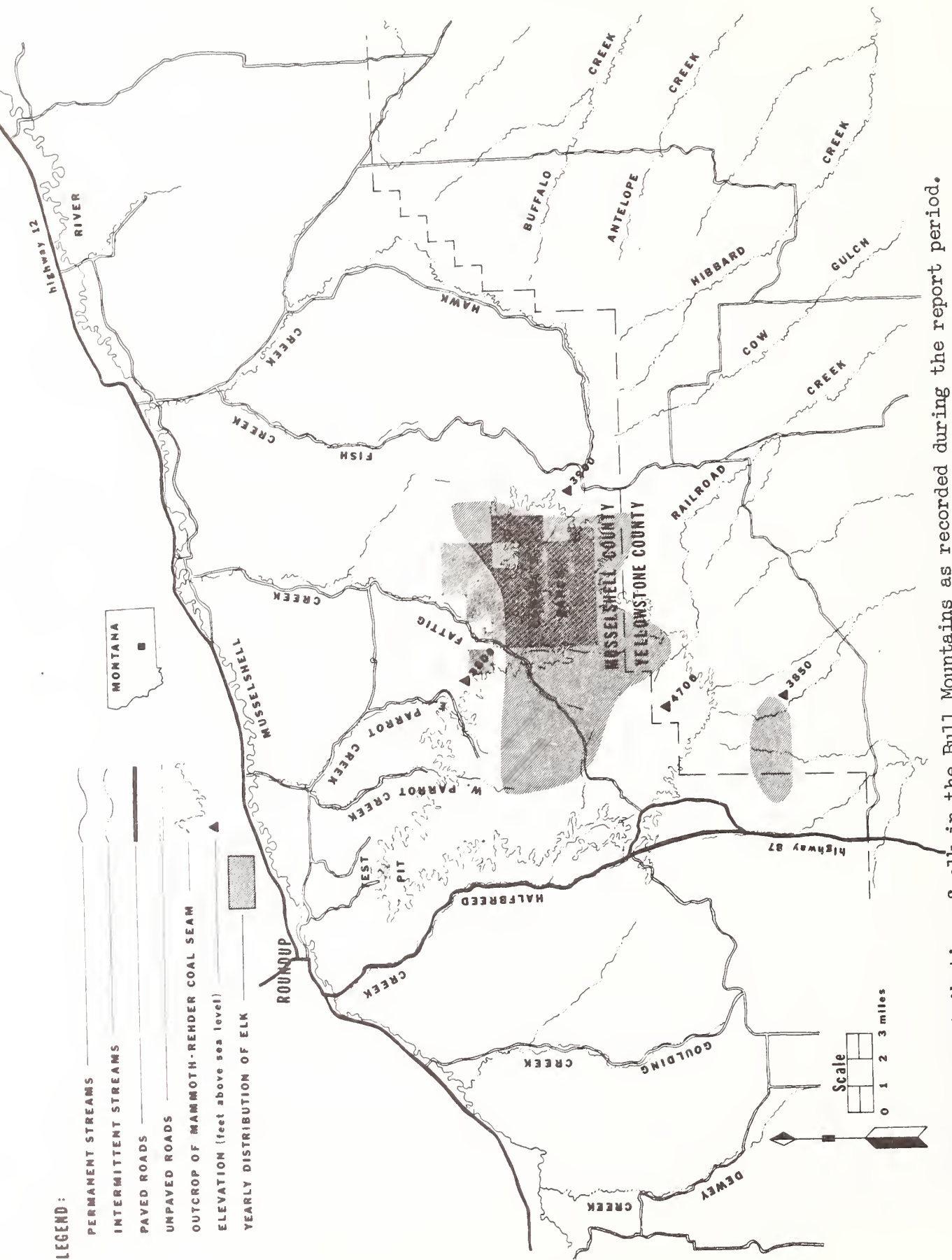


Figure 3. Distribution of elk in the Bull Mountains as recorded during the report period.

Fall: During fall, 1972, when 117 observations were obtained, 30 percent occurred in the hay meadow type (Table 5). The grassland and ponderosa pine-bunchgrass types accounted for 21 and 19 percent of the observations, respectively. This was the only season when observations were made on all vegetation types (Table 5).

Winter: All 45 observations recorded during winter, 1972-73 occurred in the grassland type, primarily in open parks. Mackie (1970) found western wheatgrass to be the most important item in the diet in the Missouri breaks during winter. This species of grass occurs in the grassland type in the Bull Mountains.

Table 5. Seasonal use of vegetation types by elk as determined from ground and aerial data combined based on 198 observations.

Season	Vegetation Type					
	Ponderosa Pine- Bunchgrass	Grass- land	Crop- land	Hay Meadow	Sagebrush- Grassland	Deciduous Shrub
Spring, 1972 (36) ^{1/}	32 ^{2/}	47	-	28	22	-
Fall, 1972 (117)	19	21	12	30	7	10
Winter, 1972-73 (45)	-	100	-	-	-	-

^{1/} Sample size for a respective season.

^{2/} Percent of seasonal observations.

Use of Slopes

Spring: During spring, 1972, 44 percent of the observations occurred in coulee heads, most of which were surrounded by precipitous terrain including rim-rocks and steep timbered slopes. Plateaus and sidehills accounted for 28 and 22 percent of the observations, respectively (Table 6). Use of plateaus by elk during this season corresponded with use of the hay meadow type.

Fall: Coulee heads, which accounted for 38 percent of the observations during fall, 1972, provided the most important slope class used by elk. Twenty-seven percent of the observations occurred in coulee bottoms which exhibited their highest annual use. This was the only time of year that elk were observed in creek bottoms when 19 percent of the observations occurred on this class of slope (Table 6).

Winter: Forty-nine percent of the observations occurred on sidehills during the winter of 1972-73 when this class of slope received its greatest seasonal usage by elk. Ridges and coulee heads accounted for 24 and 20 percent of the use, respectively (Table 6).

Table 6. Percent use by season of the various classes of slope by elk as determined by ground and aerial observations combined.

Season	Class of Slope					
	Sidehill	Coulee Bottom	Creek Bottom	Ridge	Plateau	Coulee Head
Spring, 1972 (36) ^{1/}	22 ^{2/}	6	-	-	28	44
Fall, 1972 (117)	11	27	19	4	1	38
Winter, 1972 (45)	49	2	-	24	4	20

^{1/} Sample size for a respective season.

^{2/} Percentage of seasonal observations.

Population Characteristics

During the fall of 1972, elk were more readily classified to sex and age than during other seasons. One hundred seventeen animals, the largest seasonal sample size, were classified. With the larger sample size, cow:calf and adult:calf ratios should more reliably reflect conditions in the population. During other seasons, sample sizes were smaller, calves were not readily observable, and animals were generally more difficult to classify.

Cow:calf and adult:calf ratios during fall, 1972, were 100:41 and 100:33, respectively (Table 7). The adult:calf ratio was perhaps overestimated, because very few spike or yearling bulls were observed during this season. Most of the bulls accompanying harems were mature bulls with a few raghorn bulls present. Coop (1971), in the Little Belt Mountains, reported a drop in the number of observations of yearling bulls from July through mid-October while observations of older bulls increased. During the present study, only two observations of spike bulls were made during the fall of 1972, both during late October and November.

The calf:cow ratio obtained during the report period was comparable to the ratio of 38:100 reported for the East Boulder Plateau in the Beartooth Mountains (Knapp, 1973). A calf:cow ratio of 57:100 was reported for both the Missouri breaks and the Little Belt Mountains (Mackie, 1970 and Coop, 1971). Elk have never been legally hunted in the Bull Mountains as opposed to the other three areas mentioned.

Table 7. Population characteristics of elk as determined from 117 observations from the air and ground combined during the fall of 1972.

Season	Adults			Calves	Total	Calves:Cow	Calves:Adult
	Fem.	Males	Total				
Fall, 1972	71	17	88	29	117	41:100	33:100

Turkeys

According to records of the Department of Fish and Game, turkeys were introduced in the Bull Mountains in 1958 with a release of 54 birds. The first group of 18 was released south of the community of Musselshell in the Hawk Creek vicinity during February and the second group of 36 was released near the town of Musselshell in December. The first hunting season on turkeys in the area, a 1-day season, occurred in 1962. Since 1967, seasons have lasted 2 to 3 weeks, coinciding with those on deer. Until the present time there has been no spring gobbler season in the Bull Mountains. Ranchers in the area have become possessive with turkeys as well as with other game species. For this reason, and because most of the land is privately owned, access for the purpose of hunting is limited.

Distribution and Range Use

Since their introduction, the distribution of turkeys has expanded from the Hawk Creek area westward to the Goulding Creek area (Figure 4). Twenty-four birds were trapped and marked in the upper end of East Parrot Creek during February, 1972. Each bird was marked with a poncho-type marker similar to that described by Pyrah (1970) as well as one metal and one colored plastic legband. Most relocated birds had lost the ponchos by early fall.

All marked turkeys were relocated several times in the area where marked until the large wintering flock broke up into smaller groups in late March and early April of 1972. Since that time, eight definite relocations were obtained. Of these, 2 were observed within 2 miles of the trap site, 5 were observed 5 to 8 miles away, and 1, in February, 1973, was relocated in the Hawk Creek area, 16 airline miles away from the trap site. Although the bird which moved 16 airline miles was a female, age was undeterminable, because the individually marked poncho was missing. In the Long Pines of southeastern Montana, the longest direct airline movement reported by Jonas (1966) was 14.5 miles by a yearling male. It was determined during that study that annual movement for juveniles was greater than for any other age class.

During winter, turkeys appeared to be confined in close proximity to major drainages in the Bull Mountains. With the breakup of large wintering flocks during spring, birds tended to disperse throughout the foothills. This situation continued throughout the summer period. During fall, birds again drifted toward the major drainages.

Use of Vegetation Types

Use of vegetation types is based on observations of 992 turkeys during the report period.

Winter: During the winters of 1971-72 and 1972-73, 55 and 50 percent of the observations, respectively, occurred in farmsteads or feedlots. Use of these areas, which occurred primarily in the early morning and evening hours, was supplemented by use in other vegetation types during the middle of the day.

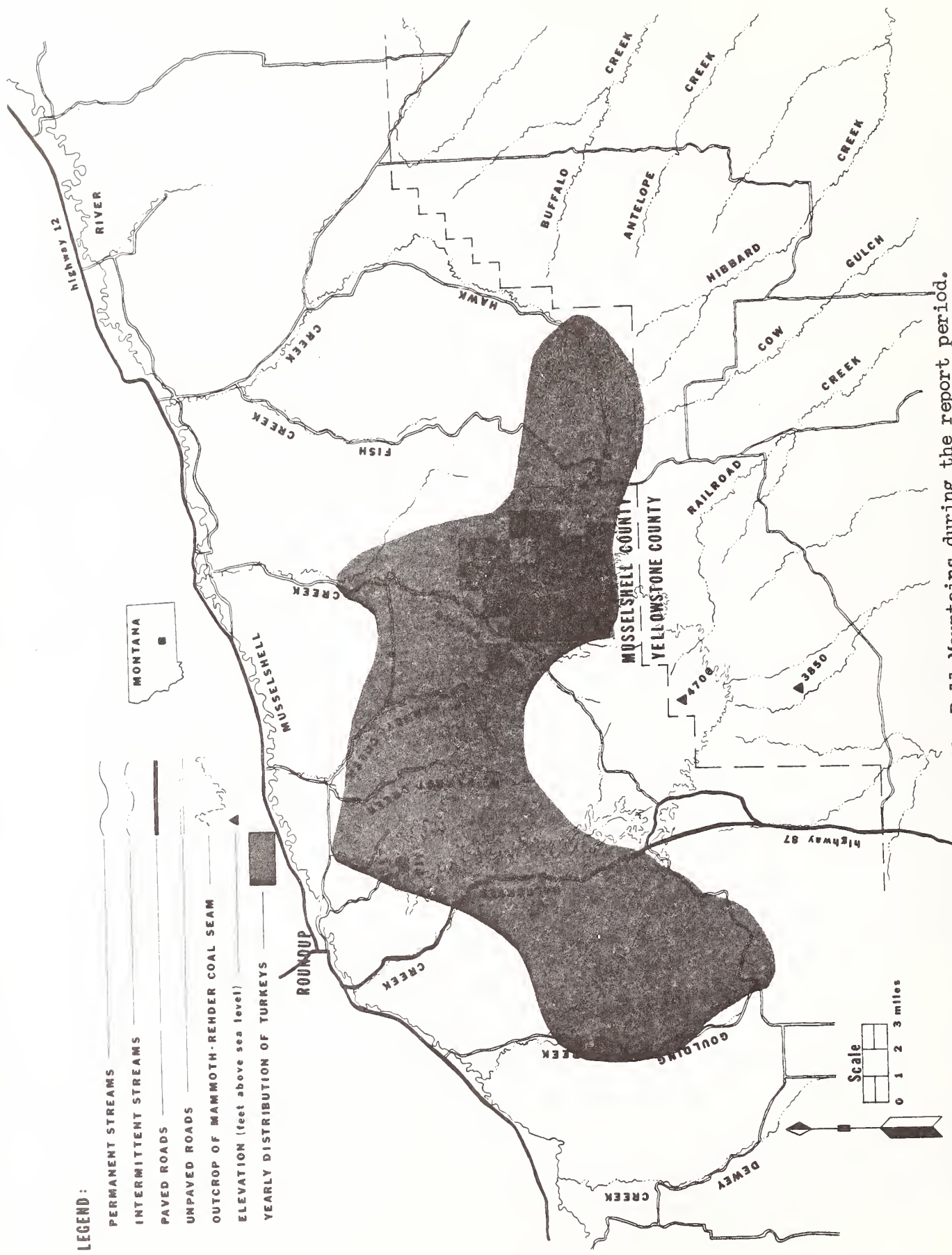


Figure 4. Distribution of turkeys in the Bull Mountains during the report period.

Roosting areas for birds using farmsteads and feedlots were in close proximity to these areas. When disturbed, turkeys used timbered types for escape cover. Forty-five percent of the observations during the winter of 1971-72 were in the ponderosa pine-bunchgrass type as compared to 7 percent the following winter. During the mild winter of 1972-73, 21 and 18 percent of the use occurred in the cropland, primarily stubble, and grassland types, respectively (Table 8). In the Long Pines, Jonas (1966) reported 73 percent of the observations during winter occurred in a deciduous tree-shrub type in drainage bottoms. This or even a similar type does not occur in the Bull Mountains.

Spring: During spring, 1972, the grassland type accounted for 77 percent of the seasonal usage. The remaining observations during this season occurred primarily in the ponderosa pine-bunchgrass and sagebrush-grassland types (Table 8). As mentioned previously, turkeys used timbered types for escape cover when alarmed.

Summer: Forty-two percent of the observations during the 1972 season occurred in the grassland type, followed by the hay meadow type with 39 percent. Other types used, as shown in Table 8, included the ponderosa pine-bunchgrass, sagebrush-grassland, ponderosa pine and deciduous shrub types. These findings are similar to those of Jonas (1966) in the Long Pines.

Fall: During this season the grassland type, which accounted for 40 percent of the observations, was again used more than any other type. The hay meadow and cropland types, which accounted for 27 and 22 percent of the observations, respectively, were also important (Table 8). Stubble from recently harvested grain accounted for all the use in the cropland type.

Table 8. Percent use of vegetation types by turkeys as determined from 992 ground observations.

Season	Vegetation Type							
	Ponderosa Pine	Ponderosa Pine- Bunchgrass	Grassland	Cropland	Hay Meadow	Sagebrush- Grassland	Deciduous Shrub	Farmstead ^{4/}
Winter:								
1971-72 (207) ^{1/}	-	45 ^{2/}	-	-	-	-	-	55
1972-73 (254)	-	7	18	21	4	-	-	50
Spring:								
1972 (274)	tr ^{3/}	17	77	-	tr	4	tr	-
Summer:								
1972 (108)	3	11	42	-	39	5	1	-
Fall:								
1972 (149)	-	11	40	22	27	-	-	-

^{1/} Sample size for a respective season

^{2/} Percent of seasonal observations

^{3/} Tr - trace - less than one percent of seasonal observations

^{4/} Not a vegetation type but rather an artificial situation

Use of Slopes

Winter: Creek bottoms accounted for the greatest seasonal use during both winters, accounting for 48 and 75 percent of the observations for the winters of 1971-72 and 1972-73, respectively (Table 9). Sidehills received the second greatest use accounting for 45 and 18 percent of observations for the respective years. Coulee bottoms received 7 percent of the use during both years with no use recorded on the remaining three classes of slope.

Spring: During spring, 1972, creek bottoms and sidehills accounted for 37 and 35 percent of the usage, respectively. Seventeen, 6 and 4 percent of the observations occurred in coulee bottoms, ridges and plateaus (Table 9). During this season, decreased use of creek bottoms, as compared to winter, and greater usage of other classes of slope corresponded with the breakup and dispersal of large wintering flocks.

Summer: During summer, 1972, all classes of slope were used (Table 9). Coulee bottoms, which accounted for 35 percent of the observations, received the greatest seasonal use. Sidehills, creek bottoms and coulee heads received 26, 19 and 10 percent of the use, respectively.

Fall: Coulee bottoms again received the greatest use, accounting for 38 percent of the seasonal observations. Use of this class of slope corresponded with use by turkeys of the grassland type during both summer and fall. Creek bottoms and plateaus accounted for 19 and 17 percent, respectively, of the seasonal use. Sidehills and ridges each accounted for 13 percent of the observations.

Table 9. Percent use of the various classes of slope by turkeys as determined from 992 ground observations.

Season	Class of Slope					
	Sidehill	Coulee Bottom	Creek Bottom	Ridge	Plateau	Coulee Head
Winter:						
1971-72 (207) ^{1/}	45 ^{2/}	7	48	-	-	-
1972-73 (254)	18	7	75	-	-	-
Spring:						
1972 (274)	35	17	37	6	4	-
Summer:						
1972 (108)	26	35	19	6	4	10
Fall:						
1972 (149)	13	38	19	13	17	-

^{1/} Sample size for a respective season

^{2/} Percent of seasonal observations

Flocking

During the report period, 853 turkeys were observed in gobbler, hen, brood, mixed and courtship flocks (Table 10). Data for the two winters were combined.

Winter: Most of the birds observed during this season were in mixed flocks consisting of individuals of all age classes and both sexes. During winter, when this type of flocking was most prominent, mixed flocks averaged 63 birds per flock. Smaller groups of males, or gobbler flocks, averaged eight in number. Jonas (1966) determined that hens seldom formed flocks. During the present study only one flock of 10 hens was observed during winter.

Spring: During spring, 1972, composition of flocks reflected breeding activities. The mixed flocks of 40 birds during March broke up into courtship flocks, averaging six birds, in early April. The number of males per courtship flock varied from one to six, and for females one to eight. The average number of males per gobbler flock was two, which was somewhat less than the figure reported for winter (Table 10). Jonas (1966) found no evidence of yearling males breeding during the study in the Long Pines. Watts and Stokes (1971) determined, for the Rio Grande turkey (*M. gallopavo intermedia*) in Texas, that dominant males within dominant sibling groups do most of the breeding.

Summer: During summer, 1972, brood flocks and gobbler flocks were most prominent. Brood flocks, which were often composed of more than 1 brood, averaged 16 birds per flock. Jonas (1966) and Watts and Stokes (1971) reported that individual broods combined to form larger brood flocks during their respective studies. Males, never observed with broods during this season, occurred in gobbler flocks averaging four birds per flock.

Fall: Turkeys of both sexes and all age classes were banding together during this season to form mixed flocks which averaged 15 birds. Several brood flocks were also observed (Table 10). Gobbler flocks averaged seven birds per flock which represented an increase over summer.

Table 10. Seasonal flocking of 853 turkeys during the report period.

	<u>Winter^{1/}(331)^{2/}</u>			<u>Spring 1972(265)</u>			<u>Summer 1972(108)</u>			<u>Fall 1972(149)</u>		
	<u>No.</u>	<u>Fl.</u>	<u>Avg.</u>	<u>No.</u>	<u>Fl.</u>	<u>Avg.</u>	<u>No.</u>	<u>Fl.</u>	<u>Avg.</u>	<u>No.</u>	<u>Fl.</u>	<u>Avg.</u>
Gobbler	67	8	8	37	17	2	29	7	4	15	2	7
Hen	10	1	10	29	12	2	2	2	1	-	-	-
Brood	-	-	-	-	-	-	64	4	16	45	4	11
Mixed	254	4	63	120	3	40	13	3	4	89	6	15
Courtship	-	-	-	79	14	6	-	-	-	-	-	-

^{1/}Data for the two winters were combined

^{2/}Sample size for a respective season

Population Characteristics

Twenty-five broods, which included 104 poults, were observed from July through September, 1972. Average brood size was 4.2 poults (Table 11). According to department records the same figure was 5.0 in 1970. During 1972, the average number of poults per adult female and average number of poults per adult were 4.0 and 1.4, respectively. The respective figures reported in 1970 were 4.7 and 2.1.

The nesting and incubation period for turkeys in the Long Pines occurred throughout the latter part of April and the first 3 weeks in May (Jonas 1966). Precipitation in the Bull Mountains during this period in 1972 was above normal (Appendix Table 15) and included several periods of extremely heavy rains. Some nests probably were destroyed and renesting attempts may have occurred. This assumption is based on observations of vast differences in size of poults between broods or within a brood flock during the period of July through September.

Data from the Long Pines (Jonas, 1966) suggested that turkeys in that area exhibited an annual mortality rate of greater than 50 percent whether the population was hunted or not. A similar situation occurred in the Bull Mountains when 56 percent of the turkeys observed from July through September, 1972, were birds of the year.

Table 11. Population data for turkeys covering the period of July-September, 1972, based on 186 observations.

Period Covered	No. Broods	No. Young	Avg. Brood Size	Adults			Young: Adult F.	Young: Adult
				M.	F.	Total		
July- Sept., 1972	25	104	4.2	45	27	72	4.0:1	1.4:1

Rest-Rotation Grazing Study

A study of livestock/wildlife relationships will be conducted on surface acreage owned and leased by Consolidation Coal Company (Consol) which is located on Fattig Creek in Musselshell County (Figure 1). This phase of study was undertaken with the following objectives: to study the effects of systematic grazing on range quality and habitat use by wildlife in the Bull Mountains; to determine how such a program may be implemented to aid in reclamation of spoil material resulting from surface mining in the area; and to develop criteria that may aid in successful reclamation as it concerns wildlife in future mining operations.

To date, information on a species by species basis concerning the effects of systematic grazing on wildlife is generally lacking. Gjersing (1971) stresses the importance of increased vegetational cover, as a result of rest-rotation grazing, upon production of waterfowl in northcentral Montana. It has also been suggested that systematic grazing practices can keep interspecific competition between mule deer and cattle at a minimum (Dusek, 1971).

At the present time no systematic grazing programs are in operation in the portion of the Bull Mountains occurring in Musselshell County. One reason for this is that public lands, administered by the Bureau of Land Management, occur only in a few small and isolated tracts, making it impractical for consideration of allotment management programs in this area. On the other hand, in northern Yellowstone County, where public lands occur in larger blocks, 7 allotments involving 23,000 acres are presently under rest-rotation grazing systems (U.S. Department of Interior, B.L.M., 1973). Even with this in mind, the vast majority of surface acreage in the Bull Mountains is under no management program at all. Year-long grazing is a common practice on privately owned lands with the Consol unit no exception. Many drainage bottoms appeared to have been overgrazed during the summer of 1972. In addition to having little or no available forage for wildlife, many of these areas are infested with broom snakeweed, considered to be an invader on overgrazed lands. This species has little or no known value to livestock or wildlife as forage. Its presence might suggest a long history of overgrazing in the area.

Range Use by Cattle

Occurrence of cattle on the various vegetation types and slopes was recorded from late spring through the summer of 1972 on the Consol unit. Data for this period are shown in Tables 12 and 13.

Range use by livestock was not quantitatively studied during the winter of 1972-73. When cattle were removed from the Consol unit in the fall of 1972, horses were pastured during winter where cattle had spent the previous spring, summer and fall.

Use of Vegetation Types

During late spring, 1972, the grassland and sagebrush-grassland types each received 38 percent of the use (Table 12). The ponderosa pine-bunchgrass type, the only other type where observations were recorded during this season, accounted for 24 percent of the seasonal use.

The ponderosa pine-bunchgrass and grassland types accounted for 48 and 40 percent of the observations, respectively, during summer, 1972. The sagebrush-grassland type accounted for 10 percent of the observations. Minor use was recorded on the deciduous shrub type (Table 12).

Table 12. Percent of seasonal use of vegetation types by cattle on Consol's Ranch in the Bull Mountains.

Season	<u>Vegetation Type</u>					
	<u>Ponderosa Pine</u>	<u>Ponderosa Pine-Bunchgrass</u>	<u>Grass-land</u>	<u>Hay Meadow</u>	<u>Sagebrush-Grass-land</u>	<u>Deciduous Shrub</u>
Spring, 1972 (112) ^{1/}	-	24 ^{2/}	38	-	38	-
Summer, 1972 (181)	-	48	40	-	10	2

^{1/}Seasonal sample size

^{2/}Percent of seasonal observations

Table 13. Percent of seasonal use of the various classes of slope on Consol's Ranch.

Season	<u>Slope</u>				
	<u>Sidehill</u>	<u>Coulee Bottom</u>	<u>Ridge</u>	<u>Plateau</u>	<u>Coulee Head</u>
Spring, 1972 (112) ^{1/}	39 ^{2/}	60	1	-	-
Summer, 1972 (181)	41	49	3	2	5

^{1/}Seasonal sample size

^{2/}Percent of seasonal observations

Use of Slopes

Shortly after being placed on the area during spring, 1972, 60 percent of the cattle observations occurred on coulee bottoms. Firebaugh (1969) and Dusek (1971) reported that cattle tended to concentrate in drainage bottoms when first placed on a grazing unit. Creek bottoms on this unit were fenced separately and used as special use pastures, which precluded any determination of preferences for creek bottoms on the Consol unit. Thirty-nine percent of the observations occurred on sidehills, mostly on gentle slopes just adjacent to coulee bottoms.

During summer, all classes of slope were used by cattle. Use of coulee bottoms, 49 percent, decreased from spring (Table 13). Forty-one percent occurred on sidehills. Minor use was recorded for coulee heads, ridges and plateaus. Most pastures in the unit were grazed continuously throughout the spring, summer and fall with only one pasture not containing any cattle until mid-summer. Exhaustion of forage in coulee bottoms during spring and early summer may have forced cattle into rougher terrain.

Wildlife

Mule deer, elk and turkeys all occurred on the Consol unit (Figures 2, 3 and 4) with mule deer being observed most often. This unit lies in some of the more rugged terrain in the Bull Mountains characterized by great extremes in elevation and many steep timbered slopes. This may have influenced use of vegetation types and slopes by wildlife. Data for mule deer classified in this unit (Appendix Tables 17 and 18) can be compared with that from the entire Bull Mountains (Tables 1 and 2). Data on turkeys and elk were too scanty to allow any comparisons to be made.

On the Consol unit, use of the Ponderosa Pine-Bunchgrass Type, during spring, summer and fall, 1972, when data was sufficient to make comparisons, was greater than in the entire Bull Mountains area (Table 1 and Appendix Table 17). The Cropland Type did not occur in the Consol unit in contrast to the rest of the Bull Mountains.

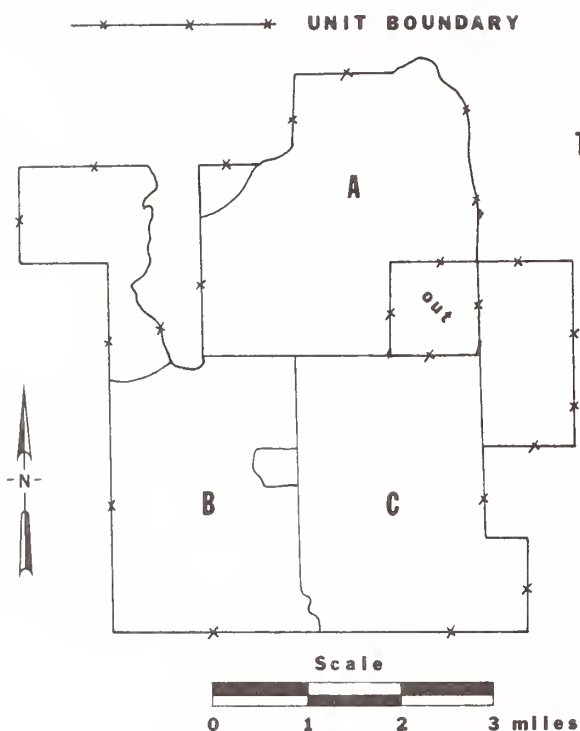
Use of the various classes of slope by mule deer was similar in both areas except that sidehills received greater usage on the Consol Unit than did coulee bottoms during summer as opposed to data from the entire Bull Mountains (Table 2 and Appendix Table 18). Coulee heads also appeared to receive greater use on the Consol unit.

Grazing Management Plan

The principles of rest-rotation grazing have been outlined by Hormay (1970). Technical assistance for the Consol unit was provided by the Soil Conservation Service. This included a range survey to determine stocking rates and a plan for a three pasture rest-rotation system to be implemented during the spring of 1976 when the next lease period begins. Separate plans were drawn up for pastures in the unit not included in the three pasture system. A six month grazing season will commence May 1, 1976 and end November 1 with livestock being absent for the rest of the year.

During the first year, pasture A (Figure 5) will be grazed from May 1 to approximately August 1 or until the time of seed ripening in pasture B. Then pasture B will be grazed from approximately August 1 until November 1 for seed trampling. Unit C will not be grazed for the entire season

CONSOL UNIT:



GRAZING SCHEDULE: 1976

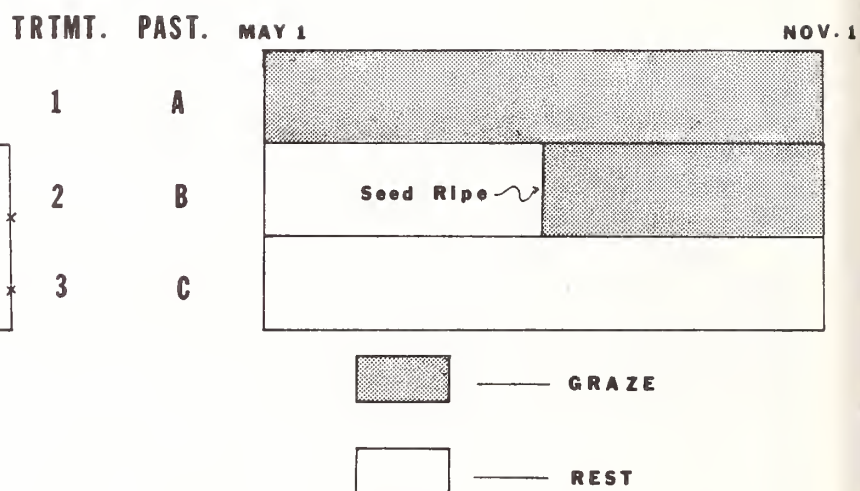


Figure 5. Map of Consol unit showing treatment pastures (left) and grazing schedule for first year of rest-rotation grazing system (right).

to allow for seedling establishment, accumulation of litter, etc. Each pasture will receive each of the three treatments during the 3-year cycle.

Transects will be placed for the purpose of determining vegetational trends under the system. Mule deer are presently being marked and trapped in the Consol unit to determine range use habits in relation to use of the area by livestock.

Revegetation Studies

During the report period, this phase of study was conducted at Consolidation Coal Company's test pit (Figures 1 and 6). Permits for surface mining were awarded by the Montana Department of State Lands to three mining companies that supply coal to Roundup and adjacent areas. Mining, which includes 7 to 12 acres, is presently in progress on each of these sites, but no seeding was attempted during the report period.

Stripping operations began at Consol's test pit, located approximately 4.5 miles southeast of Roundup, in early August, 1971. Overburden was stripped from approximately 6 acres of the Mammoth coal seam, although the total area affected included about 12 acres. Preparation of the seed bed and seeding were conducted by the Montana Agricultural Experiment Station (MAES) during the first half of May, 1972.

The purpose of the project was two-fold: i.e., to test burn the 39,000 tons of coal from the pit and determine the burning qualities, and to use the site as a test of reclamation procedures.

To test various mixtures of soil and degrees of slope, reclamation plots consisted of two ridges of spoil material west of the pit (Figures 6 and 7). The ridges consist of slopes varying from approximately 1.25:1 to those that are nearly level. Part of the spoils ridges were covered with a layer of topsoil, while the remaining spoils were covered with various mixtures of substrata including sandstone, shale and a combination of the two. According to the MAES, the entire area was seeded, primarily by hand, with one basic mixture and fertilized aurally with one chemical mixture.

Vegetational Analysis

During July, 1972, 15 permanent vegetational analysis stations were placed on the various mixtures of soil and degrees of slope. Each transect was analyzed by a canopy coverage method similar to that described by Daubenmire (1959). On each site, vegetation within each of 20 2x5 decimeter plots was analyzed along a 100-foot transect line with each plot spaced 5 feet apart. Results are shown in Table 14. Due to their phenology when transects were read, wheatgrasses (Agropyron spp.) and ryegrass (Lolium multiflorum) were not distinguishable and were therefore combined in the following analysis. The same is true for alfalfa and yellow sweetclover.

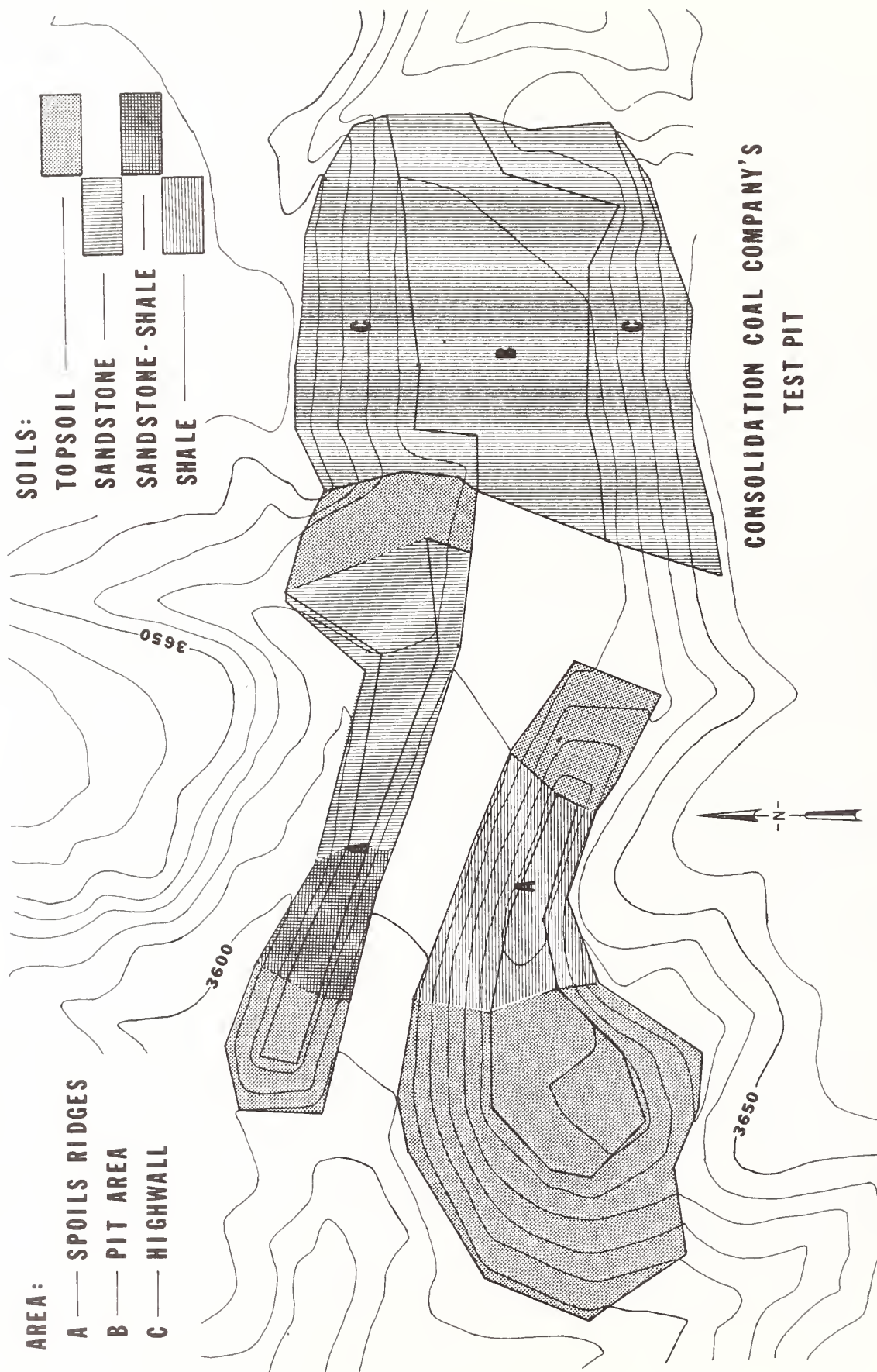


Figure 6. Map of Consol's test pit area showing respective areas and soil mixtures.



Figure 7. Two spoils ridges (top) and pit and south highwall (bottom) at Consol's test pit prior to seeding.

Table 14. Constancy, percent canopy coverage and frequency of low-growing vegetation on various types of soil and slope on spoils material as determined by examination of 20 2x5 decimeter plots on each of 15 sites at Consol's test pit.

Taxa	Soil			Slope			
	Topsoil 7 Sites	Sandstone 5 Sites	Sandstone and Shale 2 Sites	Shale 1 Site	1.25:1-2:1 5 Sites	2.5:1-3:1 5 Sites	Level 5 Sites
Grasses:							
Agropyron-Lolium spp.	100/14/92 ¹	100/ 7/81	100/ 2/38	1/70 ²	100/ 4/67	100/13/85	100/11/90
Bromus tectorum	43/tr/ 32	20/ 1/ 5	-	-	20/tr/ 2	40/ 1/ 6	20/tr/ 1
Sorghum sudanense	100/ 6/48	20/ 1/ 7	50/tr/ 3	-	40/ 2/14	80/ 4/27	60/ 2/31
Unidentified Grass	-	60/tr/ 5	100/tr/10	-	80/tr/ 7	-	20/tr/ 2
Total Grasses	100/18/94	100/ 7/87	100/ 2/50	1/70	100/ 5/74	100/16/87	100/13/97
Forbs:							
Artemisia frigida	14/tr/ 1	-	-	-	-	-	20/tr/ 2
Atriplex spp.	71/tr/ 6	20/tr/ 2	-	tr/10	20/tr/ 1	80/tr/ 7	40/tr/ 4
CRUCIFERAE	14/tr/ 1	-	-	-	-	-	20/tr/ 1
Geum triflorum	57/tr/ 3	-	-	-	-	40/tr/ 3	40/tr/ 2
Lappula redowskii	29/tr/ 1	-	-	-	-	20/tr/ 1	20/tr/ 1
LEGUMINOSAE	29/tr/ 1	-	-	-	20/tr/ 1	-	20/tr/ 1
Medicago-Melilotus spp.	100/14/86	100/ 8/59	100/tr/28	1/85	100/ 2/42	100/16/87	100/ 9/79
Psoralea esculenta	29/tr/ 1	-	-	-	20/tr/ 1	20/tr/ 1	-
Vicia americana	14/tr/ 1	-	-	-	-	-	20/tr/ 1
Unidentified Forbs	43/tr/ 3	-	-	-	-	20/tr/ 1	40/tr/ 3
Total Forbs	100/14/89	100/ 8/59	100/tr/28	1/85	100/ 2/42	100/16/87	100/ 9/82
Shrubs:							
Rhus trilobata	14/tr/ 1	-	-	-	-	20/tr/ 1	-
Rosa spp.	14/tr/ 1	-	-	-	-	20/tr/ 1	-
Symphoricarpos spp.	57/tr/ 6	-	-	-	-	40/tr/ 4	40/tr/ 4
Total Shrubs	57/tr/ 7	-	-	-	-	40/tr/ 6	40/tr/ 4
Bare Ground	100/80/100	100/89/100	100/97/100	98/100	100/95/100	100/78/100	100/86/100
Rock	100/ 8/66	100/33/89	100/17/98	11/95	100/30/96	100/13/64	100/10/72
1/Constancy (percent occurrence among sites)/canopy coverage (percent of area covered)/frequency (percent							

¹/Constancy (percent occurrence among sites)/canopy coverage (percent of area covered)/frequency (percent occurrence among plots).

²/tr - trace (a value less than .5 percent)

³/Canopy coverage/frequency

Soil Mixture

Topsoiled areas, regardless of slope, contained the greatest canopy of living vegetation and the smallest percentage of bare ground as compared to shaled areas where the results were the opposite (Table 14). Sandstone and sandstone-shale were intermediate to topsoil and shale as far as canopy of living vegetation was concerned.

In addition to having the greatest vegetational canopy, topsoiled areas exhibited the greatest diversity of plant species. Many of these also occurred on native range in the area (Table 14). Other types of soil, sandstone, shale and sandstone-shale, contained only those species that were seeded on the site. Species included in the seed mixture are shown in Appendix Table 19, but many were not apparent during the first growing season. Wheatgrasses and ryegrass, both of which were seeded, were the most abundant on all types of soil, decreasing in abundance, respectively, from topsoiled to shaled sites. Sudan grass (Sorghum sudanense), an introduced annual, was found on all soil mixtures except shale and showed the same order of decreasing abundance (Table 14). Alfalfa and yellow sweetclover were also most abundant on topsoiled areas. Shrubs, all of which occurred at a level of less than .5 percent, were found only on topsoiled areas.

The data presented represent only the first growing season after seeding and no far-reaching conclusions can be drawn at this time. However, this data should strengthen preconceived opinions about the advantages of using topsoil in reclamation attempts for a rapid recovery of vegetational cover. The data also indicated that chemical fertilizer may not be the necessary ingredient for reestablishing vegetation, but that perhaps other factors such as proper soil structure, porosity and the presence of organic material are more important.

Slope

When data were combined according to slope, with no regard to soil mixture, areas varying in gradient from 2.5:1-3:1 had the greatest canopy of living vegetation (Table 14). Gradients of 1.25:1-2:1 had the least. Accumulation of rock was greater on the steeper slopes. Steeper slopes also exhibited gully erosion resulting from runoff after heavy rains following seeding. As mentioned previously, this data was collected only after the first growing season; more information is necessary before definite conclusions can be drawn.

Wildlife

The only game species observed on the disturbed area during the report period was mule deer. Tracks, pellet groups and observations of deer occurred primarily on topsoiled areas during the period of September, 1972 through mid-January, 1973. Presence of deer on the site was not noticeable during other periods. Saltbush (Atriplex spp.) appeared to be the species fed upon by deer on the site. This species, not observed on native range in the Bull Mountains, occurred at a level

less than .5 percent canopy when transects were read in July, 1972. Exhaustion of palatable parts of these plants may have made the area unattractive to deer during late winter. Fences were constructed around the perimeter of the area to exclude livestock. However, livestock were often observed within the enclosure and some use on saltbush may be attributed to livestock.

NONGAME MAMMAL INVENTORY

Nongame mammals represent an important natural resource in Musselshell County. Besides the economic importance of furbearers, other species offer much in the way of aesthetic, recreational and ecological values. Some specific small mammal species may be used as an index of quality and quantity of vegetational cover in the study area. Since small mammals, like larger vertebrates, show preferences for varying habitat according to individual species, a region having considerable physiographical variation should have an abundant and diversified mammal fauna as opposed to an area having a limited variation. This diversity was indicated and is illustrated by studying the following data and range maps of the various nongame mammals found in the study area (Appendix Figures 11 and 12).

The small mammals accounted for in the following descriptions and range maps were captured in a continuing study of the area. Fifty-five sites (Appendix Figure 11) were trapped in Musselshell County since 1970 with each site consisting of 5 lines of 100 snap traps placed 10 feet apart. The traps were left on the grid line for two consecutive nights. At the end of the second night, population counts were calculated according to Zippin's formula (1958):

$$N = \frac{(Y_1)^2}{Y_1 - Y_2}$$

N = Total population
Y₁ = First night's catch
Y₂ = Second night's catch

Through experimentation, little difference was determined between the three night exposure method and Zippin's method (Smith, 1966). Trapping according to this method resulted in 55,000 trap night exposures, but no correction for sprung traps in catch/effort calculations were made (Nelson and Clark, 1973).

Snap traps were baited with rolled oats or a mixture of peanut butter and rolled oats. The larger nongame mammals were trapped with steel jawed traps placed according to a best set method, not a census method. These were baited with the necessary lure to draw the animal into the trap. Each mammal was identified by skull and pelage characteristics (Hall and Kelson, 1959; Hoffman and Pattie, 1969; Larrison, 1967; and Booth, 1961). Representative animals from each site were preserved in a study collection.

Species Account

Common Deer Mouse

The deer mouse (Peromyscus maniculatus osgoodii) is the most abundant small mammal in Musselshell County. It is recognized by white feet, buff brown top, white underneath, bicolored tail and large visible ears.

This species is found in a wide variety of habitats and occupies the entire study area. Trap data indicated this species is most commonly found in the open sagebrush-grassland habitat, although its presence has been established in the ponderosa pine-grassland areas of the county.

Habitat requirements include a fairly open canopy of vegetation with an abundant amount of seeds for food, although insects and berries are sometimes used (Martin, et al, 1951). Census data obtained since 1970 indicate that when the vegetational canopy of an area increases to a certain undetermined factor, deer mice may disappear. They are sometimes replaced by Microtus species which exhibit different food preferences (Martin, et al, 1951), and a canopy dense enough to formulate runways (Ingles, 1967; Maser and Storm, 1970).

A population study of deer mice has been in progress since the fall of 1970 in Musselshell County. A population decline was noted from 45 to 4 mice per 1,000 linear feet from 1970 to 1972, respectively (Figure 8). The reason or reasons for this drop in population are not clear at this time. Possible explanations include: (A) increased mortality rate, (B) decreased litter size, (C) hormonal factors, and (D) variables influencing movement (King, 1968).

Meadow Vole

The partial interrelationship between this species and deer mice has previously been described.

Meadow voles (Microtus pennsylvanicus insperatus) are medium sized mice with a smooth, slick, dark brown fur. The tail is bicolored and considered to be very short when compared with the tails of other mice.

In Musselshell County, the vole appeared to occupy areas of good ground cover and residual vegetation. Trap data indicated migration to areas that appeared to have an increased canopy of vegetation. The Musselshell River appears to be the distribution separation between meadow voles and prairie voles. However, both species appear sympatrically together along the river bottom (Appendix Figure 11, Maps 1 and 2).

Prairie Vole

This species is very similar to the meadow vole, although the fur is not as slick and differences occur in the teeth (Hoffman and Pattie, 1968). Trap data indicated this vole occupies only the area along and north of the Musselshell River (Appendix Figure 11, Map 2). The interrelationship between prairie voles

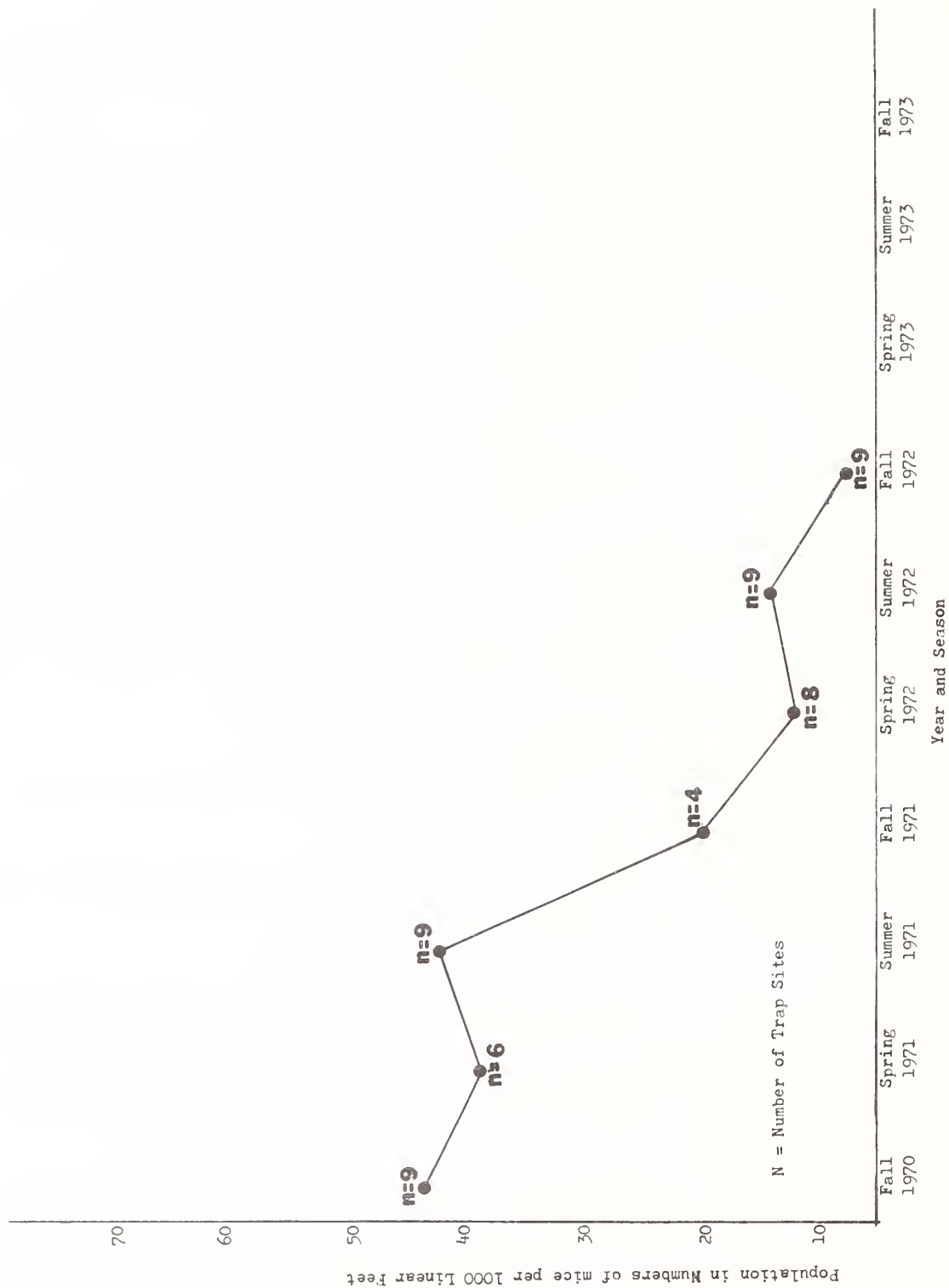


Figure 8. The population trend of deer mice over a 3-year period at trap sites in Musselshell County.

(Microtus ochrogaster haydeni) and deer mice, along with the sympatric relationship with meadow voles, has been previously mentioned.

Least Chipmunk

The least chipmunk (Eutamias minimus pallidus) is a small chipmunk which inhabits the ponderosa pine area of Musselshell County (Appendix Figure 11, Map 3). It is characterized by a general grayish color, brownish dark dorsal stripes and buffy sides. The color of trapped specimens ranged from a sagebrush gray for animals obtained in the sagebrush-grassland-park areas to a more reddish brown color for animals obtained in the ponderosa pine areas.

Yellow-bellied Marmot

The yellow-bellied marmot (Marmota flaviventris nosophora) is a large rodent with grizzled gray upper parts, black and white face and yellow intermixed throughout. The marmot's range, indicated by trap and sight data, appeared to be limited to areas which provided large amounts of rocky cover (Appendix Figure 12, Map 4).

Richardson's Ground Squirrel

The medium-sized, unstriped Richardson's ground squirrel (Spermophilus richardsonii richardsonii) is buff colored with a black-tipped tail. The range of this animal, which included primarily grasslands, appeared to increase due to observations of new colonies noticed within the study area (Appendix Figure 12, Map 5).

Northern Pocket Gopher

The northern pocket gopher (Thomomys talpoides bullatus) seems to occupy areas of Musselshell County which provide suitable food and burrowing habitat. An indication of their presence is an earthen plugged mound.

The animal ranges in color from a dark brown to buff and contains very little white on the ventral side. The fossorial front paws are tipped with long claws and the eyes are very small.

Ord's Kangaroo Rat

This species has a characteristically large head, small ears, large hind legs and a long tail with a white tuft of hair at the end. They are dark tan on the dorsal side and white ventrally. The tail is brownish gray with lateral white stripes and a ventral dark band tapers to a point near the tip. Ord's kangaroo rats (Dipodomys ordii terrosus) prefer sandy soils (Larrison, 1967) and inhabit a range indicated by Map 6, Appendix Figure 12.

Eastern Cottontail Rabbit

The eastern cottontail rabbit (Sylvilagus floridanus similis) has not been previously documented as occupying the study area (Hoffman and Pattie, 1968; Hoffman, et al, 1969). This easily identified species has been both trapped and sighted over a range that consists of the entire study area during the report period.

White-tailed Jackrabbit

This species, which is brown dorsally and white ventrally during summer and white except for dark ear tips during winter, maintains a range occupying part of the Bull Mountains. The white-tailed jackrabbit (Lepus townsendii campanius) has been frequently sighted or trapped in sagebrush-grassland areas, but is not usually found in the forested areas (Appendix Figure 12, Map 7).

Others

Nongame mammals for which data were insufficient to formulate a range included the following rodents: thirteen-lined ground squirrel (Spermophilus tridecemlineatus); black-tailed prairie dog (Cynomys ludovicianus); olive-backed pocket mouse (Perognathus fasciatus); beaver (Castor canadensis); bushy-tailed woodrat (Neotoma cinerea); sagebrush vole (Lagurus curtatus); muskrat (Ondatra zibethicus); and porcupine (Erethizon dorsatum).

Carnivores included: coyote (Canis latrans); red fox (Vulpes vulpes); raccoon (Procyon lotor); long-tailed weasel (Mustela frenata); mink (Mustela vison); badger (Taxidea taxus); striped skunk (Mephitis mephitis); and bobcat (Lynx rufus).

Test Pit Nongame Mammal Survey

The area encompassed by Consolidation Coal Company's test pit is currently being censused, both summer and winter, for nongame mammal activity.

The same census method, described previously, was used on the five trap line sites (Figure 9). Line sites A and E were located on the undisturbed perimeter of the area, and lines B, C and D were placed to encompass the entire disturbed area. Small mammal census trapping before, during and after mining activity is being continued in the area to determine movements and activities of animals related to revegetation studies.

The 1970 fall census data, obtained before mining, indicated the same number of deer mice as the surrounding area (Figure 8).

Data obtained during mining indicated an increase of 2 mice per 1,000 linear feet in sites A and E. This increase is perhaps due to some migration of deer

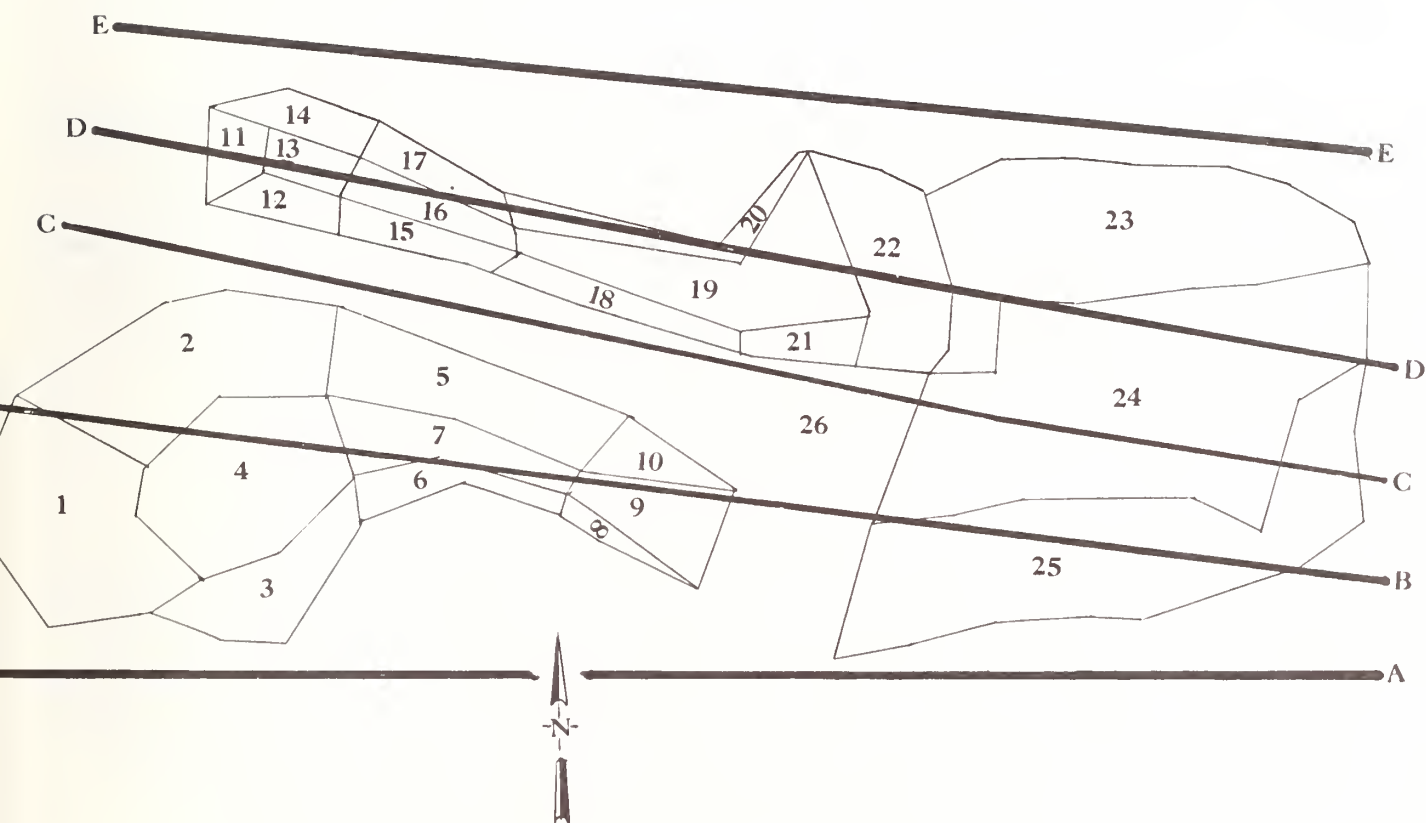


Figure 9. Winter study (numbered) areas and summer (lettered) census lines.

mice from the mining area since the population in lines B, C and D was completely eliminated due to mining.

Census data after mining in 1972 indicated a normal population, as compared with the surrounding areas, in sites A and E (Figure 8). Lines B and D contained one-half the population of lines A and E. All deer mice trapped on B and D were adult males which indicated a partial reestablishment of population in these areas (King, 1968). No specimens were trapped in 1972 on line C.

In order to study small mammal activity during winter, the test pit area (Figure 9) was divided into 26 sections. The time for each of 10 visits was determined by the amount of fresh snow that had fallen the night before. The activity of different nongame mammals was determined by fresh tracks in the new snow. One set of tracks entering a given area was considered to be one instance of usage by one of the animals.

White-tailed jackrabbits, coyotes and deer mice were the only nongame animals evident in the area during the winter of 1972-73. The number of instances of use by each species, according to test pit numbered areas, is shown in Figure 10. The data indicate a selectivity for topsoiled areas by the three species. The areas of heavy use were topsoiled areas, except for areas 23, 24 and 25, which received some instances of use. This use did not penetrate the areas to any extent, but was maintained near the perimeter on the south and east sides. This can be explained further by the fact that both areas 23 and 24 were bordered on the south and east by rocky outcrops which may have provided protection for the animals during winter.

DISCUSSION

The area overlying the Mammoth-Rehder coal bed as well as adjacent areas is characterized by greater extremes in elevation, more rugged terrain, and a greater interspersion of timbered and nontimbered types than outlying areas of the Bull Mountains. Since suitable wildlife habitat includes proper interspersion of such habitat requirements as food, cover, water and security, the area mentioned would probably best meet the habitat requirements of resident wildlife in this region. Based on this premise, it is understandable that the distribution of mule deer, elk and Merriam's turkey occurred primarily in this area as illustrated in Figures 2, 3 and 4.

A deficiency or absence of one or more habitat requirements would serve as a limiting factor to wildlife populations. For example, the absence of a deciduous tree-shrub type in drainage bottoms, the key winter habitat for turkeys in the Long Pines (Jonas, 1966), may somewhat limit turkeys in the Bull Mountains. This may be one reason for the heavy use of and/or dependence upon feedlots and farmsteads during winter. MacDonald and Jantzen (1967) indicated that cultivated areas are a good source of feed for turkeys in areas that are heavily overgrazed in portions of New Mexico.

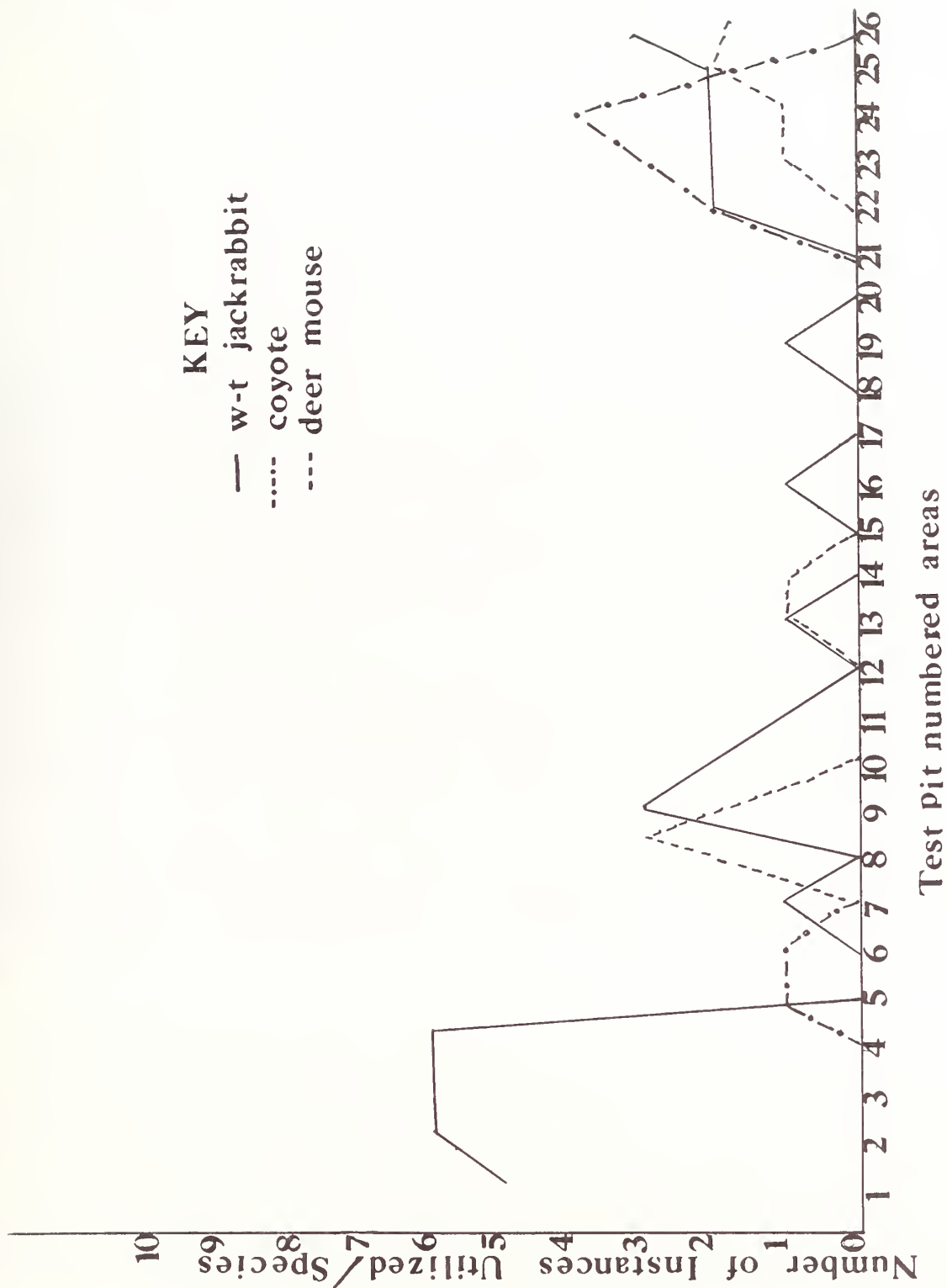


Figure 10. The number of instances of use, by species, on test pit numbered areas.

All observations of elk during the report period were in areas where numbers of cattle were few or absent. During all periods of the year, except during fall, elk occupied areas of rugged terrain where use by cattle may have been limited. In the Missouri breaks Mackie (1970) reported an opportunity for direct and intensive interaction between elk and cattle during early spring and fall when food habits of both classes of animals were similar.

Because mule deer are not as adaptive in their feeding habits as elk, they must depend upon certain kinds of forage throughout the year to maintain the herd in a healthy condition. This includes not only quantity, but quality of forage as well. Based on the low fawn:doe ratios obtained during the report period, these conditions apparently are not being realized. Since deer and cattle both preferred drainage bottoms during summer, heavy grazing by livestock appeared to limit areas used by deer, and consequently, the availability of forage. During this time of year forbs, primarily common salsify, were the most important in the diet of mule deer. During winter when browse was the most important forage class in the diet of deer, silver sagebrush was the most important single item followed by skunkbush sumac. Silver sagebrush is considered a staple in the diet of mule deer during this period in eastern Montana, since its use does not normally exceed its abundance as opposed to rubber rabbitbrush which is a preferred item (Dusek, 1971). Due to its limited abundance and distribution in the Bull Mountains, the latter species is of little or no importance to mule deer. Skunkbush sumac is used during late summer and fall in eastern Montana (Mackie, 1970 and Knapp, 1972) but is normally not considered to be of any importance during winter. A lack of an adequate harvest of deer due to limited access to the area by hunters would definitely have to be considered a key factor contributing to low fawn:doe ratios.

The material discussed above tends to substantiate the need for intensive study of the effects of rest-rotation grazing upon wildlife populations in the Bull Mountains. Findings from such a study may provide needed information to help solve wildlife problems in areas where livestock production is the major land use.

Based on present knowledge of reclamation in eastern Montana, it is difficult to project the long-term effect of strip mining upon wildlife in the Bull Mountains. Any disturbance of surface acreage including critical wildlife habitat would be detrimental, at least temporarily. If the area mined could not be reclaimed to meet all disturbed habitat requirements, the damage definitely would be permanent.

Jonas (1966) described suitable habitat for turkeys as those areas which include proper interspersions of ponderosa pine with nonforested types, rugged terrain and a food supply. Present knowledge of reclamation practices does not guarantee any specific arrangement of plant communities. If it were possible, microclimatic and edaphic conditions, of which plant communities are believed to be a result, would have to be created before a vegetational cover could be established. Topographical patterns are also important in providing security for wildlife as well as influencing growth and arrangement of vegetational cover. If the steep precipitous terrain, where most elk were observed, were mined, the subsequent reclamation may allow these areas to become more accessible to livestock which could, in some cases, be detrimental to elk and/or mule deer.

This report contains only the preliminary findings for which this study was initiated. More data, especially in the area of reclamation, are necessary before any specific techniques or innovations in the reclamation process can be recommended. For the present, any area considered to be of critical importance to wildlife should not be mined until it is demonstrated that such areas can be successfully reclaimed to their former condition.



APPEND IX



Table 15. Climatological data gathered by the Department of Commerce for Roundup, Montana, covering the period January, 1972 - February, 1973.

Month	Temperature		Precipitation	
	Average	Departure from Normal	Average	Departure from Normal
January:				
1972	17.3	- 6.4	.58	.29
1973	26.7	.2	.06	- .26
February:				
1972	29.5	3.0	.27	- .05
1973	26.7	.2	tr	- .32
March:				
1972	43.0	9.3	.29	- .27
April:				
1972	46.3	.6	1.64	.89
May:				
1972	56.0	.2	3.00	1.20
June:				
1972	68.4	5.2	.61	-1.92
July:				
1972	68.0	- 4.1	1.50	.29
August:				
1972	71.4	1.6	3.06	2.09
September:				
1972	52.3	- 7.3	.81	- .15
October:				
1972	41.8	- 7.4	.91	.09
November:				
1972	31.7	- 4.4	tr	- .36
December:				
1972	15.8	-13.2	.53	.17

Table 16. List of plant species collected in the Bull Mountains during spring and summer, 1972.

<u>Monocots</u>				
<u>Family</u>	<u>Genus</u>	<u>Species</u>	<u>Common Name</u>	<u>Symbol</u>
Gramineae	Agropyron	A. smithii	Western Wheatgrass	Agsm
	Koeleria	K. cristata	Junegrass	Kocr
	Phleum	P. pratense	Timothy	Phpr
	Poa	P. secunda	Sandburg Bluegrass	Pose
	Stipa	S. viridula	Green Needlegrass	Stvi
Liliaceae	Allium	A. textile	Onion	Alte
	Calochortus	C. gunnisoni	Mariposa Lily	Cagu
	Fritillaria	F. pudica	Yellow Bell	Frpu
	Leucocrinum	L. montanum	Mountain Star Lily	Lemo
	Smilacina	S. stellata	Starry False Solomon's Seal	Smst
	Zygodenus	Z. paniculatus	Foothill Death Camas	Zypa
<u>Dicots</u>				
Compositae	Achillea	A. millefolium	Yarrow	Acmi
	Antennaria	A. rosea	Rose Pussytoes	Anro
	Artemisia	A. frigida	Fringed Sagewort	Arfr
		A. ludoviciana	Cud-leaf Sagewort	Arlu
		A. tridentata	Big Sagebrush	Artr
		A. sororia	Arnica	Arso
	Arnica			ASTER
	Aster			
	Balsamorhiza	B. sagittata	Arrowleaf Balsamroot	Basa
	Chrysopsis	C. villosa	Golden Aster	Chvi
	Chrysothamnus	C. nauseosus	Rubber Rabbitbrush	Chna
	Ecinaceae	E. pallida	Purple Coneflower	Ecpa
	Erigeron	E. humilus	Erigeron	Erhu
	Gutierrezia	G. sarothrae	Broom Snakeweed	Gusa
	Helianthus	H. annuus	Common Sunflower	Hean
		H. nuttallii	Nuttall Sunflower	Henu
	Hymenoxys	H. acaulis		Hyac
	Liatris	L. punctata	Dotted Blazingstar	Lipu
	Microseris	M. cuspidata		Micu
	Ratibida	R. columnifera	Prairie Coneflower	Raco
	Senecio	S. serra	Groundsel	Sese
	Solidago	S. canadensis	Canada Goldenrod	Soca
		S. missouriensis	Goldenrod	Somi
	Taraxicum	T. officinale	Common Dandelion	Taof
Chenopodiaceae	Eurotia	E. lanata	Winterfat	Eula

Table 16 Continued. List of plant species collected in the Bull Mountains during spring and summer, 1972.

<u>Family</u>	<u>Genus</u>	<u>Species</u>	<u>Common Name</u>	<u>Symbol</u>
Boraginaceae	Cryptanthus	C. bradburiana	Miner's Candle	Crbr
	Lappula	L. redowskii	Western Sticktight	Lare
	Lithospermum	L. incisum	Narrowleaf Gromwell	Liin
Labiatae	Monarda	M. fistulosa	Horse Mint	Mofi
Ranunculaceae	Anemone	A. patens	Pasque Flower	Anpa
	Delphinium	D. bicolor	Low Larkspur	Debi
	Ranunculus	R. glaberimus	Sagebrush Buttercup	Ragl
Polemoniaceae	Phlox	P. hoodii	Hood's Phlox	Phho
Plantaginaceae	Plantago	P. purshii	Woolly Plantain	Plpu
Rosaceae	Frageria	F. virginiana	Virginia Strawberry	Frvi
	Geum	G. triflorum	Prairiesmoke	Getr
	Prunus	P. virginiana	Chokecherry	Prvi
	Rosa	R. arkansana	Prairie Rose	Roar
Umbelliferae	Lomatium	L. cous	Mountain Lomatium	Loco
		L. foeniculaceum		Lofo
Primulaceae	Dodecatheon	D. conjugens	Shootingstar	Doco
Anacardiaceae	Rhus	R. trilobata	Skunkbush Sumac	Rhtr
Saxifragaceae	Ribes	R. aureum	Golden Currant	Riau
Leguminosae	Astragalus	A. gilviflorus	Three-leaved Milkvetch	Asgi
		A. pectinatus	Narrowleaf Poisonvetch	Aspe
	Glycyrrhiza	G. lepidota	Wild Licorice	Glle
	Lupinus	L. argenteus	Silvery Lupine	Luar
	Oxytropis	O. besseyi	Bessey Pointvetch	Oxbe
		O. sericea	White Pointloco	Oxse
	Petalostemon	P. purpureum	Purple Prairie Clover	Pepu
	Psoralea	P. argophylla	Silverleaf Scurfpea	Psar
		P. esculenta	Breadroot Scurfpea	Pses
	Thermopsis	T. rhombifolia	Prairie Thermopsis	Thrh
	Vicia	V. americana	American Vetch	Viam
Polygonaceae	Erigonum	E. ovafolium	Oval-leaf Buckwheat	Erov
Onagraceae	Oenothera	O. albicaulis	Whitestem Evening Primrose	Oeal
	Gaura	G. coccinea	Scarlet Gaura	Gaco

Table 16 Continued (2). List of plant species collected in the Bull Mountains during spring and summer, 1972.

<u>Family</u>	<u>Genus</u>	<u>Species</u>	<u>Common Name</u>	<u>Symbol</u>
Malvaceae	Sphaeralcea	S. coccinea	Scarlet Globemallow	Spco
Violaceae	Viola	V. nuttalli	Nuttall Violet	Vinu
Caryophyllaceae	Cerastium	C. arvense	Field Chickweed	Cear
Scrophulariaceae	Castilleja	C. sessiflora	Indian Paintbrush	Case
	Orthocarpus	O. luteus	Yellow Owl Clover	Orlu
	Penstemon	P. albidus	White Penstemon	Peal
		P. eriantherus	Fuzzytongue Penstemon	Peer
		P. nitidus	Waxleaf Penstemon	Peni
Papavaraceae	Argemone	A. intermedia	Prickly Poppy	Arin

Table 17. Percent use of vegetation types occurring on the Consol unit by mule deer as determined by ground and aerial observations combined.

<u>Season</u>	<u>Vegetation Type</u>					
	<u>Ponderosa Pine</u>	<u>Ponderosa Pine-Grassland</u>	<u>Grassland</u>	<u>Hay Meadow</u>	<u>Sagebrush-Grassland</u>	<u>Deciduous Shrub</u>
Spring, 1972 (63) ^{1/}	52 ^{2/}	52	19	3	16	5
Summer, 1972 (65)	3	35	35	12	2	12
Fall, 1972 (49)	-	16	71	12	-	-

^{1/}Seasonal sample size
^{2/}Percentage of seasonal observations

Table 18. Percent use of the various classes of slope on the Consol unit by mule deer as determined by ground and aerial observations combined.

<u>Season</u>	<u>Slope</u>					
	<u>Sidehill</u>	<u>Coulee Bottom</u>	<u>Creek Bottom</u>	<u>Ridge</u>	<u>Plateau</u>	<u>Coulee Head</u>
Spring, 1972 (63) ^{1/}	57 ^{2/}	13	3	6	14	6
Summer, 1972 (65)	28	17	5	17	21	12
Fall, 1972 (49)	8	10	18	6	33	24

^{1/}Seasonal sample size
^{2/}Percentage of seasonal observations

Table 19. Species list for mixture seeded at Consol's test pit.

Grasses

Western wheatgrass
Pubescent wheatgrass
Streambank wheatgrass
Crested wheatgrass
Tall wheatgrass
Field brome
Smooth brome
Sudan grass
Orchard grass
Barnyard grass
Ryegrass
Canada bluegrass
Prairie sandreed grass
Alkali grass
Green needlegrass
Cheyenne winter wheat

Forbs

Yellow sweetclover
Cicer milkvetch
Fourwing saltbush
Goldenrod
Onion

Trees and Shrubs

Ponderosa pine
Skunkbush sumac
Silver sagebrush

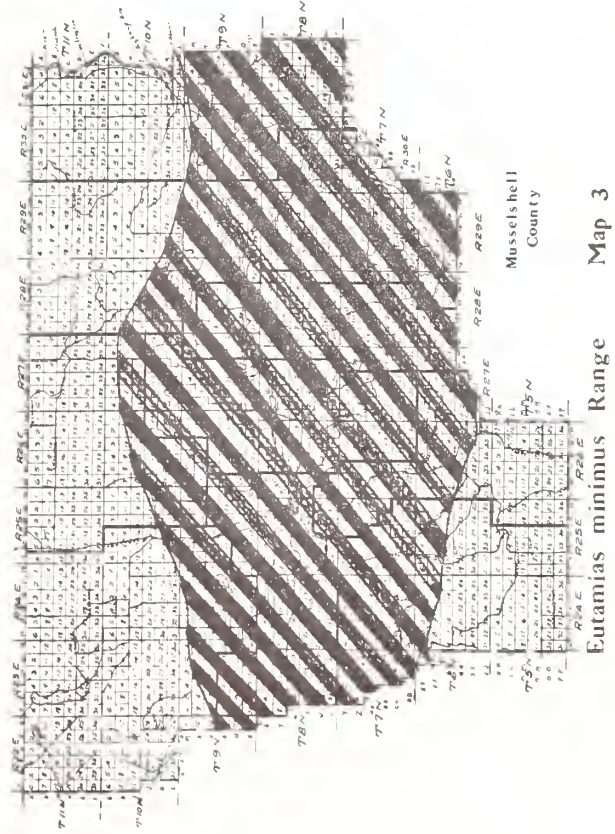
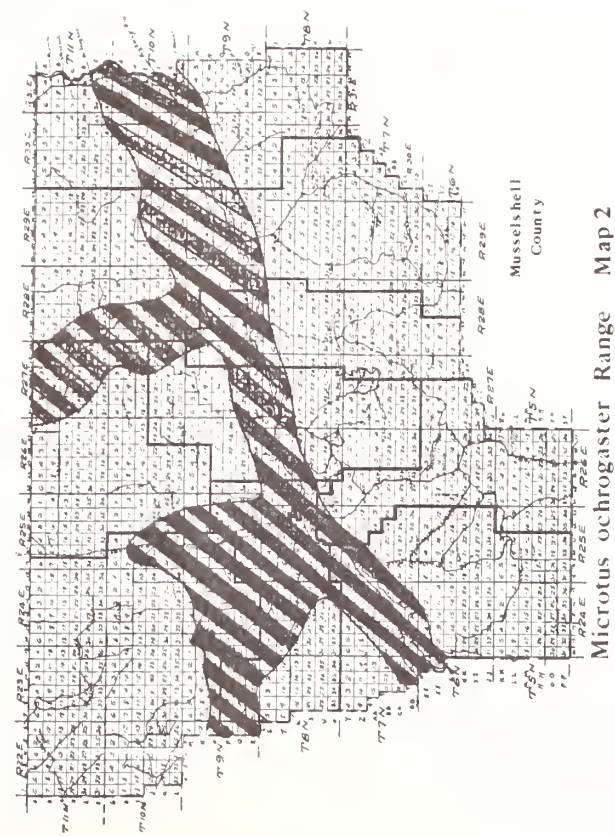
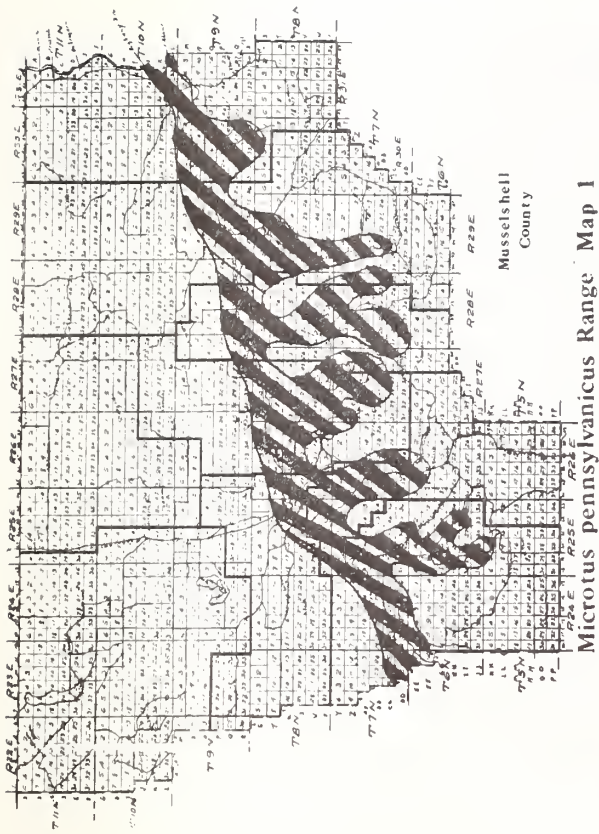
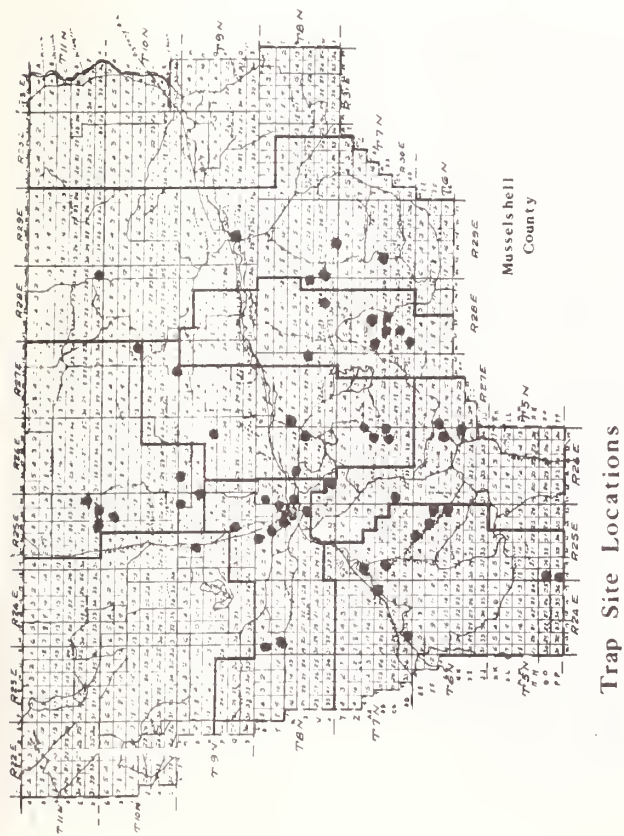


Figure 11. Trap sites and distribution maps.

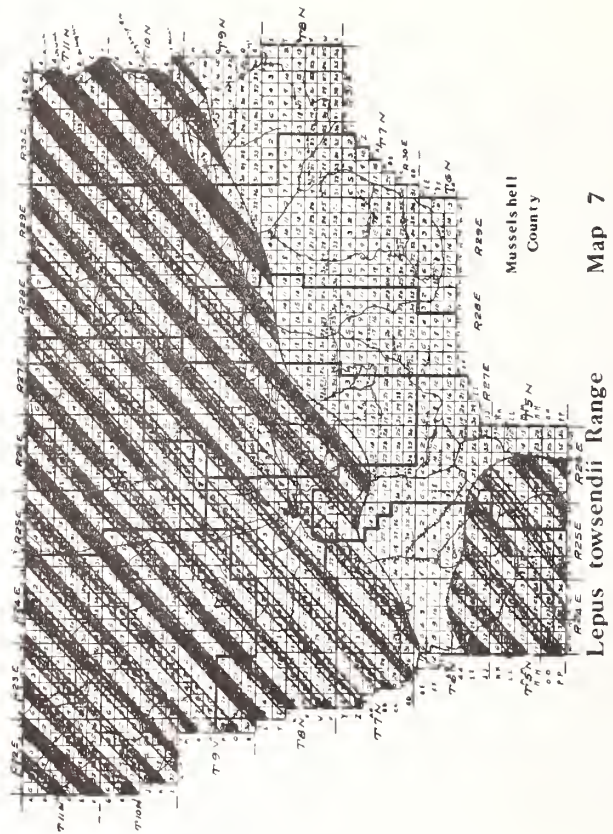
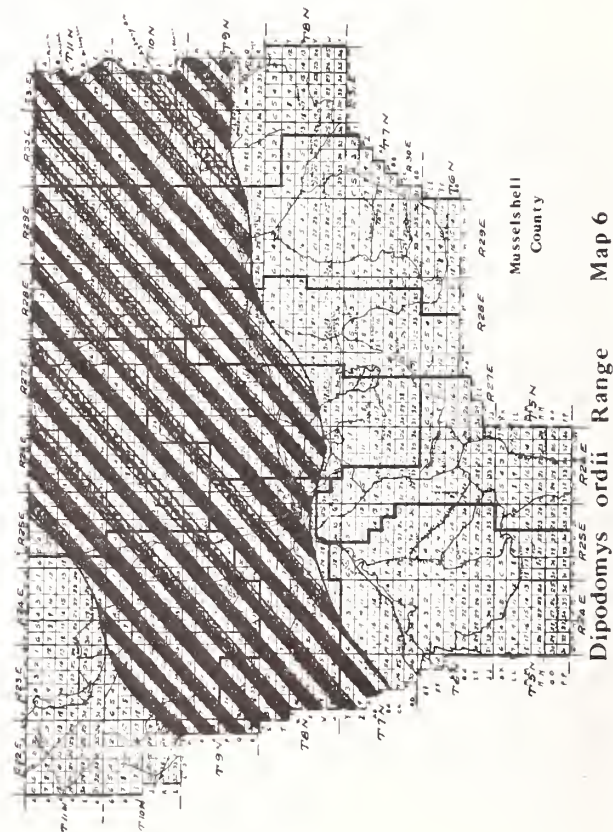
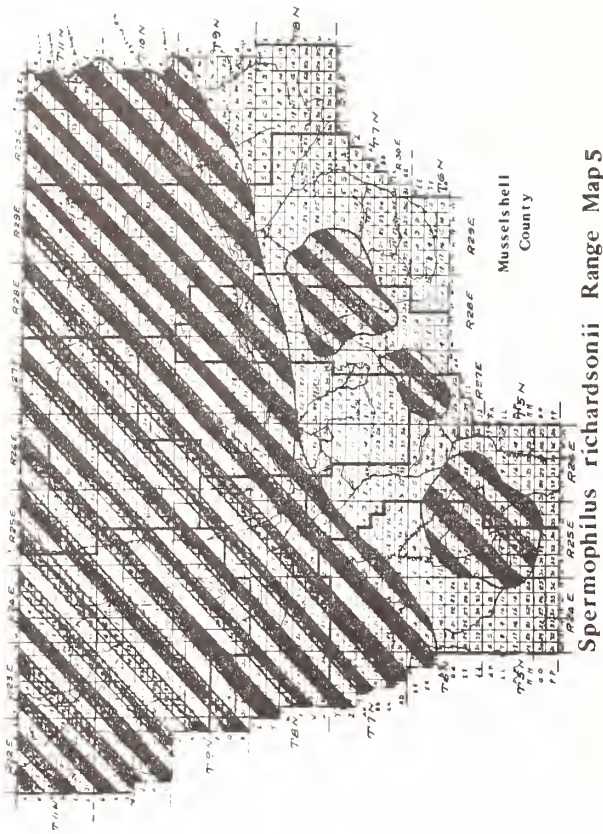
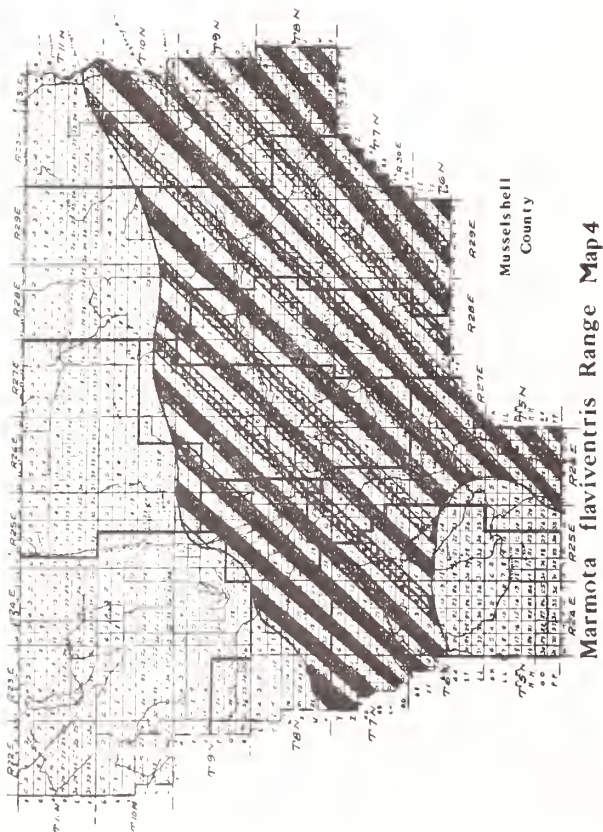


Figure 12. Distribution maps.

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